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The Effect of Constant Time Delay and Sentence Frames on Correct Word Selection for Sentences Constructed Using Technology-Aided Instruction During a Story-Based Lesson

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ABSTRACT

The Effect of Constant Time Delay and Sentence Frames on Correct Word Selection for Sentences Constructed Using Technology-Aided Instruction During a Story-Based Lesson

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The purpose of this study was to investigate the effect of an intervention package that included constant time delay (CTD) and sentence frames on correct word selection for sentences constructed using technology-aided instruction (TAI) during and following a story-based lesson (SBL) for participants ages 6-8 who have intellectual disability, developmental delays, and autism (IDD). A multiple probe across participants design was used to evaluate the efficacy of the intervention. Probes were conducted during baseline, intervention, generalization, and maintenance phases to determine the effectiveness of the intervention on correct word selection for sentence construction. Results indicate a functional relation between the intervention package on correct word selection for sentence construction during a shared story. Additionally, the Percent of Nonoverlapping Data (PND) indicate overall strong effects. Finally, students were able to demonstrate both generalization and maintenance of skills.

DEDICATION

I would like to dedicate this thesis to the two most important men in my life, my partner Keith Erwin, whose steadfast love and support have been catalysts to keep me going, and Zeb Williams, my son, whose encouragement and voiced views of my abilities and talents gave me belief in myself when my load got a little too heavy to bear. Both men sacrificed tremendously during my pursuit of higher education, and those sacrifices did not go unnoticed. Keith read and edited every paper and project I have completed over the past two years and, likely, could implement numerous evidence-based practices with ease, although he's never taught a day in a special education classroom. Zeb ate more pizza pockets, more Chinese food, and less vegetables than I would have liked, but his insistence on feeding himself so I could work relieved me of the guilt I would have felt otherwise, and for that I am grateful. There hasn't been a lot of fun in our funmily over the last two years, but there will be a ridiculous amount of fun in the future we are all building together. Luh, luh K-Man and Bug! We did it!

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Chapter 1. Introduction

While research on effective methods of teaching reading, literacy, math, and science to students with extensive support needs (ESN) were beginning to emerge in the early 2000s (Browder et al., 2006b; Browder et al., 2008b; Courtade et al., 2007; Erikson et al., 2005), very few studies were done in the area of written expression. Joseph and Konrad (2009) noted that between 1986 and 2007 only nine studies were conducted regarding the effectiveness of written expression strategies with students with intellectual disabilities and autism. Findings indicate that the participants benefited from writing instruction, in particular, when strategy instruction was used. Self-regulated strategy development (SRSD) proved to be the most frequently used strategy, with writing quality and accuracy being the most frequent outcomes measured. Recommendations for further research included research related to writing instruction, including instructional components such as reinforcement, opportunities to respond, corrective feedback, etc., and their effectiveness in teaching written expression to students with intellectual and developmental disabilities. Historically, due to deficits in the major skills needed for writing, writing instruction for those with extensive support needs was complicated or nonexistent. However, due to a few studies conducted, several strategies, such as SRSD, began to emerge and show promise.

Explicit and Systematic Instruction in Writing

With studies indicating the effective use of explicit, systematic instruction (SI) in teaching reading (Browder et al., 1984; Browder et al., 1990; Rohena-Diaz & Browder, 1996), literacy (Browder et al., 2007a; Browder et al., 2007b; Erikson et al., 2005), math (Colyer & Colling, 1996; Schloss et al., 1997), and science (Courtade et al., 2007), researchers began to

explore its use in teaching written expression. Pennington et al. (2011) used a single case multiple probe across participants design to investigate the impact of simultaneous prompting and computer-assisted instruction on story-writing among three students with autism in a self-contained classroom. Results indicate that simultaneous prompting paired with computer-assisted instruction were effective in teaching students with autism to write a story that consisted of four sentences. The sentences included one stating the character, one stating the setting, another stating an action, and a final sentence stating the consequence of the first action or an action that occurred as a result of the first action. There were several limitations to this study including the researcher not conducting three replications of the treatment or causal effects, not assessing participants' ability to read story vocabulary prior to intervention, and only presenting three story templates rather than a variety of templates. Suggestions for future research included exploring the effectiveness of using computer-assisted instruction, such as the Clicker 5 app, to teach students to produce writings related to grade-level content, personal narratives, and social communications such as emails and texts. Additionally, the authors recommended that practitioners explore how pictures paired with words might inhibit students' ability to acquire words needed for writing.

Continuing the study of effective instructional practices in written expression, research into the use of simultaneous prompting and computer-assisted instruction to teach writing to students with IDD began to emerge. Pennington and Koehler (2017) investigated the use of modeling, story templates, and self-graphing and their effectiveness on teaching the inclusion of story elements in narratives written by middle schoolers with moderate disabilities. Three participants, ages 12-13 with moderate intellectual disabilities, were shown videos lasting four minutes or less. Each video, which was selected to be engaging, contained all story elements.

Participants were provided with two randomly chosen narrative templates containing sentence frames with blank spaces for participants' answers. Explicit and systematic instruction, including prewriting and modeling, were used and then faded. Following this, participants graphed their progress with a focus on the number of story elements included in their writing. Findings indicate that there was a functional relation between the writing intervention and the number of story elements participants included in their narratives. Adding to strategies already found to be effective, this study indicates that students with ESN can be taught narrative writing with the support of modeling, story templates, and self-graphing, which is an important part of a comprehensive writing program.

A Model for Teaching Basic Sentence Writing

When doing a synthesis of literature on the use of assistive technology and SI, Pennington (2016) described a model for teaching basic sentence writing to students with moderate to severe disabilities. As a result of his review, he recommended a four-step approach. The first step involves planning for meaningful opportunities in which students' prior knowledge is activated, appropriate motivation to write is present, and students' writing skills gradually become more sophisticated. The second step includes selecting assistive technology that meets the students' accessibility needs, provides auditory feedback, and opens other arrays of pictures or choices. Third, Pennington recommended the use of research-based strategies such as CTD, simultaneous prompting, system of least prompts, and sentence frames with attention being paid to prompting, fading of prompts, and feedback. Finally, educators must monitor students' progress to ensure interventions are effective and students are making adequate progress. This 4-step approach lays out a process by which educators can begin to plan for appropriate written expression instruction for their students with more extensive support needs.

Increasing Rigor in Writing

Increasing the rigor of instruction by expanding the writing process, Mims et al. (2017) conducted research on the effectiveness of technology-based instruction on opinion writing skills. Three participants, ages 10-14 with significant intellectual disabilities, used an adapted text with picture supports and a read aloud via the iPad app *GoBook* that accompanied the text. Given the app, students were able to choose a topic to write about, an opinion on their topic, a fact to support their opinion, a second fact to support their opinion, and a concluding sentence. Students were allowed to change their choices during the writing process. Participants' sentences were scored correct if the appropriate answer was chosen and placed in the blank to complete the sentence within 5 seconds. Researchers also rated the level of participants' engagement. Using assistive technology and explicit instruction, all three students made gains in opinion writing using the intervention package, although the data show variability. Results of this study indicate that students with IDD could be taught to not only write sentences but also to construct persuasive paragraphs. Limitations of this study include the possibility that two of the participants' responding levels may not have been accurately assessed due to the use of only one probe being administered prior to beginning the intervention. In addition to this, the researchers did not assess participants' ability to read pictures and words or their understanding of vocabulary related to the adapted text used, and this may have had an effect on performance, in particular, different vocabulary may have affected performance on different chapters. Finally, due to issues with the *GoBook* app, participants' motivation may have been affected by the need to reboot the program resulting from malfunctions. The success of this study provides a reference for continued study related to and the development of comprehensive literacy programs that include a writing component for students with IDD.

Pennington et al. (2018b) continued the study of writing instruction and increased rigor using a multiple probe across behaviors design to investigate three middle school students' ability to generate targeted sentences using an intervention package that included CTD and a model sentence. After presenting a rule for sentences, "A sentence names a character and tells more", students were shown a picture of an animal, directed to write (i.e., "Write a sentence telling me what the _____looks like," "Write a sentence telling me what the _____ is doing," "Write a sentence telling me how the _____feels"), and shown written models they could use to assist in their writing. After writing the model sentence, students were praised, the sentence was read back to them, and the rule was reviewed and compared to their sentence for completeness. During each session, the teacher presented five trials per session All participants were able to generate all three types of sentences after intervention and maintained sentence writing above baseline. Participants also generalized this skill to their personal journals, generating more sentences after instruction. This study affirmed that students with intellectual disabilities and autism could benefit from instruction in writing. However, the authors recommended that further studies be done on the role of sentence frames during writing intervention, as they used a single sentence frame at a time, resulting in students erring in the use of that one sentence frame regardless of the writing request.

Similarly, Pennington and Rockhold (2018c), extended the work related to sentence construction using a multiple probe across behaviors design to investigate the impact of an intervention package that included CTD, multiple exemplar instruction, and assistive technology on the number of correct sentences constructed (i.e., The subject is adjective, The subject verb, or The subject verb object .) when presented with a picture of an animal and model sentence among four males ages 6-9 with autism spectrum disorder in a self-contained classroom. Results

indicate that the instructional package was effective in teaching the construction of correct sentences related to a picture stimuli. However, the results did not aid in our professional knowledge on teaching variation of sentences written in natural settings, which should be studied further.

Computer-Assisted Instruction in Writing

Furthering knowledge on how instruction on written expression can be enhanced with computer-assisted instruction, Pennington et al. (2019b), using a multiple probe across participants design, evaluated the effect of technology-based instruction using a prototype of the *GoWrite* app (Attainment Company, 2019), focusing on teaching sentence writing to students with significant disabilities. Using the *GoWrite* app, participants were shown a picture with a sentence written below it, a word bank, and given the direction, "What do you see? Write a sentence." The app prompted students to write the trained sentence by highlighting the correct responses and shading the ones that were incorrect. Following this, the app employed eight-second time delay. If the student responded correctly within 8 seconds, a student-created avatar read the sentence aloud, along with an auditory 'ping', and the student received a coin in his/her/their digital 'bank' that could later be exchanged for items or activities. Data were collected on correct construction of sentences and what selections the participants made. Findings indicate that seven of the eight participants benefited from the technology-based instructional intervention and the efficacy of response-prompting as part of academic interventions for students with significant disabilities. Using the prototype app, researchers were able to show an effect between computer-assisted instruction, paired with CTD and auditory feedback, and positive outcomes for participants in the area of sentence construction.

The aforementioned studies are limited in that they neither occurred within a natural context nor within the participants' natural routine. Skills were taught in isolation and with random stimuli that were not related to the participants' current course of study. For example, a picture of an animal was presented, and participants constructed a sentence about that animal; however, the animal, and thus the sentence, were not related to a natural context. In addition to this, while the sentence may have described what was occurring in the picture, it did not convey knowledge the participants acquired in a natural academic setting, such as a summary sentence about a story that has been read aloud during literacy group. For this reason, the focus of this study is on extending the work done by Pennington and other researchers in the area of written expression into a natural context, setting, and routine.

The purpose of the study is to expand on these and other studies by exploring the effectiveness of CTD and sentence frames as an intervention to increase the percent of correct word selection in sentence construction using TAI during and following a SBL, an academic activity that naturally occurs within the participants' regular school day, and to answer the following questions:

1. What is the effect of an intervention package that includes constant time delay and sentence frames on correct word selection for sentences constructed using technology-aided instruction during a story-based lesson?
2. What is the effect of an intervention package that includes constant time delay and sentence frames on correct word selection for a summary sentence constructed using technology-aided instruction after a story-based lesson?
3. What are the stakeholders' perceptions of the targeted intervention and outcomes?

Definition of Terms

Constant time delay (CTD)- a response-prompting strategy used in systematic instruction in which discrete and chained skills are taught by gradually increasing the amount of time between the presentation of the stimulus and the response prompt with a goal of errorless or near-errorless learning (Browder et al., 2020; Spooner et al., 2014)

COVID- related absence- an absence from school due to contracting COVID or being in quarantine as a result of being a close contact

Evidence-based practice- practices that have been shown through rigorous research and repetition of high-quality studies to be effective in producing the desired outcomes (The IRIS Center, 2021)

Explicit instruction- highly structured, systematic instruction that focuses on critical skills and content that are taught in a logical order, build upon one another, are unambiguous, and provide supports and content that is scaffolded to help guide students in their learning (Archer & Hughes, 2011).

Five-second time delay- an instructional strategy in which the target stimulus is presented and a delay interval of five seconds is employed prior to presentation of the controlling prompt (Barton & Harn, 2012)

Intellectual and developmental disabilities (IDD)- differences that are typically present at birth, but may occur before a person's eighteenth birthday, and that can affect an individual's intellectual, physical, social/ emotional development, and/or adaptive behavior skills (National Institutes of Health, 2021)

Self-Regulated Strategy Development (SRSD)- an instructional intervention in which teachers use a six-step process to teach academic strategies and self-regulation that includes activating background knowledge, discussing, modeling, and memorizing strategies, supporting the student in using the strategies via guided practice, and independent practice using the targeted strategies (WWC, 2017)

Sentence frames- a structured, fill-in-the-blank format that is scaffolded to support students in responding to a question or a prompt in the early stages of writing, that are found in many beginning writing programs, and that provide students with a visual of how words look in context and what is the logical order of words (Ferlazzo & Sypnieski, 2018)

Story-based lesson- an evidence-based practice that has been used to teach literacy to students with IDD and involves a 12-step task analysis used during a read aloud to teach grade-appropriate literacy skills including, but not limited to, engagement with text, choral reading/recitation, identification of vocabulary both in isolation and in text, and responding to comprehension questions related to the text (Browder et al., 2009b; Courtade et al., 2013; Spooner et al., 2009)

Systematic instruction (SI)- instruction based on the principles of applied behavior analysis (ABA) that employs a sequence that begins with an antecedent, followed by a prompt and a response/desired behavior, and, finally, a consequence, which is reinforcement, and in which content and skills are taught in a logical order with thorough planning and defined delivery of instruction (Browder et al., 2020)

Technology-aided instruction (TAI)- any instruction that involves the use of a computer, tablet, app, and/or digital educational game.

Zero-second time delay- an instructional strategy in which the target stimulus is presented simultaneously with the controlling prompt (Barton & Harn, 2012)

Chapter 2. Literature Review

Throughout the years humans have expressed themselves in written form. We have used symbols, pictures, and written words in many forms and for many purposes. Humans use writing to express their wants and needs, share their experiences, release emotions, and express their knowledge (Graham & Harris, 2005) and wonderings, to name a few. As a result, we now rely on writing for numerous functions. Writing is an important daily living skill and is used to make lists, communicate with others regarding resources, and to meet employment requirements. Texts, emails, notes, etc. are used for social connection and to build and sustain relationships. Writing is used for self-expression and creativity, to record one's thoughts, and to access reinforcement. Writing is also the most common way by which knowledge is assessed in educational settings. These are but a few ways people use writing to express themselves and to enhance their life experiences.

Understanding the importance of writing in the human experience, educational institutions began focusing on handwriting in the nineteenth century. At that time, importance was placed on formation of letters, legibility, and spelling. In the twentieth century, educators began focusing on the process and content of writing through the writing of narrative, descriptive, argumentative, and expository essays (Education Encyclopedia, 2021). This focus on writing and written expression continue to this day in preschools, primary schools, secondary schools, and in higher education. Given the importance placed on writing, its noted benefits, and the need for writing in today's society, it is necessary that all people, including those with extensive support needs, be taught to express themselves in written form. Historically, this has not been the case, especially for people with IDD. This study extends the current research on teaching sentence writing to students with IDD by evaluating the effect of an intervention

package that includes CTD and sentence frames on correct word selection for writing sentences using TAI when embedded in natural literacy instruction via a SBL.

The Move Towards Increased Equity and Access

In 1975, Congress enacted Public Law 94-142, the Education for All Handicapped Children Act (United States Congress, 1975). This law mandated that people with disabilities who were ages 3-21 be provided with a free appropriate public education (FAPE) in the least restrictive environment. It stipulated that children who were suspected of having a disability receive an evaluation by a qualified evaluator and that, if found eligible, parent consent must be obtained in order for the child to receive special education services. Children receiving special education services were required to have an Individualized Education Plan (IEP) that contained annual goals; however, the content and rigor of those goals were not mandated. As a result, many students with disabilities did not receive or received inadequate instruction in academic skills, including writing, and/or did not have access to the general education curriculum.

While PL 94-142 provided a FAPE for students with disabilities, many inequities remained between the education received by this population and their non-disabled peers. Some of these inequities were addressed in 1990 when the Education for All Handicapped Children Act was amended and renamed the Individual with Disabilities Education Act, or IDEA (101st Congress, 1990). Not only were traumatic brain injury (TBI) and autism (AU) added as disability categories and transition plans mandated, but access to the general education curriculum by students with disabilities also became a priority. Students with disabilities now had the same rights to access reading, writing, math, and more as their same-age nondisabled peers; however, what this access should look like was not clearly defined.

As a result of this directive, scholars began to research effective ways to include students with extensive support needs in the general education curriculum. Kliewer and Landis (1999) noted that when educators use individualized education programs based on an institutional understanding, students with moderate and severe disabilities are seen to have minimal capacity for and abilities to participate in the general curriculum. This led to students having limited experience with literacy and books. When educators approached individualization from a local understanding, they began with knowledge of the child and to think out of the box, looking for ways to include children in literacy instruction rather than excluding them. Research continued with Smith and Jones (1999) evaluating how assistive technology could facilitate access to the general education curriculum, what obstacles stood in the way of its use, and how to overcome those obstacles. Their research resulted in recommendations to not only use assistive communication devices and accessibility devices like touchscreens, but also to incorporate other forms of technology to facilitate access to and inclusion of the general education curriculum in the education of students with severe disabilities.

Although IDEA and its amendments led educators to begin thinking about inclusion in and access to the general curriculum, the real change came with the issuing of the No Child Left Behind Act (2002). No Child Left Behind (NCLB) mandated that all students be instructed on grade-level standards, giving all students access to their grade-level curriculum for the first time. (No Child Left Behind [NCLB], 2002). Excluding students with intellectual disabilities and autism from the general curriculum and grade-level standards was no longer an option. States, universities, and school districts, therefore, began to look at the needs of this population differently. Researchers began exploring ways in which the general education curriculum could be adapted to meet the needs of students with intensive needs and autism (Browder et al., 2004).

Along with accountability came the need for the use of evidence-based practices. By looking at how skills are defined and taught, educators began to include academic skills based on state standards and to use mastery criteria to measure yearly growth in students' individualized education plans (Browder & Cooper-Duffy, 2003).

In 2004, amendments were made to IDEA that required students with disabilities to have access to and make progress in the general curriculum and to be educated with students with and without disabilities. Numerous studies were conducted to evaluate the effectiveness of literacy instruction with students with more extensive disabilities. Koppenhaver et al. (2007) noted that students with severe speech and physical impairments could learn to read and write when given a well-rounded literacy program that is supported by technology in the form of augmentative and alternative communication, which is also used for writing. Browder et al. (2006a) synthesized 128 studies on teaching reading to students with significant disabilities. The authors found that systematic prompting was effective in teaching sight words and using concrete examples such as pictures was somewhat effective when teaching comprehension. Teaching students with significant disabilities phonological awareness and phonics were areas in which the authors found little research. Following this study, Browder et al. (2008a) developed a curriculum program, Early Literacy Skills Builder (ELSB), and evaluated its impact on students with significant disabilities' ability to learn early literacy skills and to improve their language. Results of the study indicate that students instructed using ELSB, which uses an explicit, systematic teaching approach and evidence-based practices, showed significant gains over students who did not receive the intervention.

Seeing gaps in IDEA, in 2015 President Barack Obama signed the Every Student Succeeds Act (ESSA) into law (Every Student Succeeds Act, 2015). Under ESSA, accountability

for all students' instruction and achievement was increased, including students who receive special education services. ESSA mandated that all students receive an education that prepares them for college and/or a career and that the use of alternative assessments, an end-of-grade assessment for students who are unable to participate in state assessments even when provided with accommodations, be capped at 1% of the student population. Such accountability requirements and restrictions on testing meant schools' funding, especially in the areas of reading and writing, were tied to the education and achievement of students with disabilities. ESSA mandates and funding pushed researchers to delve deeper into evidence-based practices in these areas for students with IDD.

Explicit Instruction and Students with Disabilities

Researchers and educators have found explicit instruction to be a cornerstone when working with students with IDD. Explicit instruction is highly structured, systematic, and focuses on critical skills and content. The skills and concepts are taught in a logical order and build upon one another. Instruction is unambiguous and includes both delivery procedures and an instructional design. Supports are provided and content is scaffolded to help guide students in their learning (Archer & Hughes, 2011). Researchers in the field of education have identified 16 elements of explicit instruction including: (a) instruction is focused on critical content, (b) skills are taught in a logical sequence, (c) complex skills and strategies are broken into small units, (d) lessons are organized and focused, (e) lesson goals and expectations are clearly stated at the beginning of the lesson, (6) before beginning new instruction, prior skills/knowledge are reviewed, (g) a step-by-step demonstration is provided, (h) clear and concise language is used, (i) both examples and non-examples are given, (j) time is allotted for guided practice and instructional support, (k) frequent opportunities to respond are provided in which students are

required to respond, (l) students' progress is closely monitored, (m) immediate affirmative and corrective feedback are given, (n) lessons progress at a brisk pace, (o) instructors facilitate the organization of information and assist students in making connections, and (p) students are provided with multiple opportunities to practice the skills taught over time with previously learned skills being embedded in that practice (Archer & Hughes, 2011).

Researchers have investigated the effect of explicit instruction on the outcomes of children with extensive support needs with positive results (Lee at al., 2016; Mims et al., 2018; Pennington & Carpenter, 2019a). Knights et al. (2011) used explicit instruction to teach science descriptors to students with autism using a multiple probe across behaviors with concurrent replication across participants design. All participants met criterion for the study, and several participants generalized the skill to new objects and pictures, including objects used for an inquiry-based science lesson. Root et al. (2017) used explicit instruction to teach three elementary school students who had been diagnosed with autism and/or a moderate intellectual disability to solve math word problems using both concrete and virtual manipulatives. Results demonstrated a functional relation between the intervention, schema-based instruction and the use of virtual and concrete manipulatives, and participants' performance when solving words problems. Not only did two participants solve more steps of word problems using virtual manipulatives, all participants also showed a preference for virtual manipulatives when given a choice. A third research team, McKissick et al. (2013), used a computer-assisted explicit instruction package to teach three students who were in elementary school map-reading skills using a multiple-probe across participants design. Two participants in the study showed a dramatic increase in their performance on map-reading; however, one student showed minimal change in trend and level, possibly due to the school year ending. Explicit instruction has been

effectively used to teach both academic and functional skills to students with IDD. When paired with SI, the evidence-based practice of explicit instruction has shown positive outcomes.

Systematic Instruction in Academics for Students with IDD

For close to 60 years, systematic instruction, which is based on the principles of applied behavior analysis (ABA), has been used to successfully teach students with developmental disabilities. When using SI, researchers and educators employ a sequence that begins with an antecedent, followed by a prompt, a response/desired behavior, and, finally, a consequence, which is reinforcement (Browder et al., 2020). First used to teach functional skills (Cuvo et al., 1981; Horner & Keilitz, 1975), SI has become an integral part of special education.

Understanding the effectiveness of SI and given the mandates of IDEA, NCLB, and ESSA, researchers began to implement the four steps of SI when investigating evidence-based practices that would allow access to and achievement of grade level content and standards for students with IDD. According to Browder et al. (2020), these steps include: (1) define the skills you would like the learner to acquire, (2) define which methods will be used during instruction, (3) implement the systematic instruction plan, and (4) monitor the student's progress to determine if modifications to instruction are needed. Noting the use of systematic prompting procedures with a predetermined plan for fading prompts and/or supports is one of the foundations of SI (Browder et al., 2020), researchers, and, subsequently, educators, began using practices such as CTD (Browder et al., 2009a; Riesen et al., 2003), simultaneous prompting (Head et al., 2011; Waugh et al., 2009), least-to-most intrusive prompts (Colyer & Collins, 1996; Mims, 2009), graduated guidance (Horrocks & Morgan, 2011; van de Meer et al., 2015), and stimulus fading or shaping (Mueller et al., 2007) as interventions when instructing students with IDD on the general education grade-level content and standards. Establishing interventions as

being evidence-based through replication of the intervention in at least three studies by two or more research teams and benefitting a minimum of three participants (Chambless & Hollon, 1998) has led to increased access to the general education curriculum (Browder et al., 2007a), improved outcomes for students with disabilities (Cook & Odom, 2013), the creation of instructional programs that meet the needs of students with extensive support needs such as Early Literacy Skills Builder (Browder et al., 2007a), increased accountability due to data collected (The IRIS Center, 2021), and teachers becoming more efficient and effective in their practice (The IRIS Center, 2021).

Jimenez et al. (2008) continued the use of SI paired with concrete representations as an intervention for students with IDD when they investigated the effect of the intervention on the ability of three high school students, all of whom had moderate intellectual disabilities, to acquire algebraic skills, in particular the ability to solve simple linear algebraic equations. Using a multiple probe across participants research design, the researchers created a task analysis of the steps needed to solve for *X* when given a simple algebraic equation. By employing concrete representations of algebraic equations, task-analytic instruction focusing on the steps needed to solve equations, and systematic fading of prompts with the goal of prompting errorless learning, participants were able to complete 8 out of 9 steps needed to solve for *X* (1 participant) or all steps required (2 participants). By using explicit, systematic instruction and evidence-based practices, participants were able to demonstrate mastery of higher level math skills than previously believed.

Not only has SI been used when teaching high schoolers math skills, it has also been used when instructing three elementary school students with IDD who were between the ages of 6 and 8 on the acquisition of science vocabulary and concepts (Smith et al., 2013). Researchers used a

multiple probe across behaviors, or science units, design. Using the *Early Science Curriculum* (Attainment Company, 2012), which included scripted lessons, a task analysis, introduction of vocabulary, explicit instruction on grade-level science concepts, and the use of inquiry skills such as making predictions and scientific experimentation, researchers explored the use of SI on the acquisition of grade-level science standards by students with IDD. Through the use of an intervention package that included systematic instruction, all study participants met criteria on end-of-unit assessments and were able to progress to the next unit of study. Given the growth participants demonstrated across phases during and post-intervention, a functional relation was established and the use of SI was further cemented as an evidence-based practice.

In 2016, Baxter continued work with systematic instruction when he used a multiple probe across participants single case design to examine the effect of an iPad app named *GoBook* (Attainment Company, 2011) and SI on listening comprehension for students with significant disabilities. The intervention package, which included CTD, the system of least prompts, and picture supports, along with the *GoBook* app, which used a SBL format to present an adapted version of *To Kill a Mockingbird* by Harper Lee, was implemented with 3 high school students who had a diagnosis of Down Syndrome and intellectual disability. The researchers investigated the intervention package on targeted vocabulary and various types of comprehension questions including: (1) predictions, (2) the main character, (3) setting, (4) the sequence of story events, (5) the main idea, (6) problems and solutions, (7) inference questions, (8) application questions, and (9) questions related to analysis. Results indicate positive outcomes and a causal effect, with each participant demonstrating growth in both vocabulary and listening comprehension when compared with baseline scores. By systematically planning instruction that is highly structured

and strategically builds on concepts, from simple to complex, researchers and educators have opened a new world of learning to students with IDD.

Constant Time Delay to Teach Academics to Students with IDD

As mentioned previously, CTD is an evidence-based practice that has been used in education and research to teach students with IDD. CTD is defined as a response-prompting strategy used in systematic instruction in which discrete and chained skills are taught by increasing the amount of time between the presentation of the stimulus and the response prompt with a goal of errorless or near-errorless learning (Browder et al., 2020; Spooner et al., 2014). In chained responses, such as those found in the author's study, skills are task analyzed and skill sequences are taught in order until the final desired skill has been demonstrated (Spooner & Spooner, 2014). CTD has been demonstrated to have strong validity when teaching both functional skills, such as functional sight words (Swain et al., 2015) and job skills (Horn et al., 2020b), and academic skills, including phonological awareness (Oliveira et al., 2018), literacy (Browder et al., 2009a; Browder et al., 2009b), math (Orihuela et al., 2018), and writing (Pennington et al., 2018a). CTD has been used by numerous researchers across multiple academic areas to teach a variety of academic skills, as it is an easy, effective, and efficient intervention to implement.

Aldemir and Gursel (2014) investigated the use of CTD to teach preschool academic skills in a small group setting to 4- to 6-year olds who had a developmental delay to evaluate the effect of the intervention package on the acquisition of preschool academic skills using a multiple probe across behaviors design. The research team created flashcards and photographs related to each participant's individualized target skills. Targeted skills included academic skills such as identifying the last one, identifying the full one, and identifying numbers. Aldemir and

Gursel reported that all participants reached criteria across targeted skills, thus indicating that CTD was an effective intervention for teaching preschool academic skills given no threats to internal validity.

Mims et al. (2018), extending the work done by Baxter in 2016, used a multiple probe across participants single case research design to investigate the effectiveness of an iPad app, *Access: Language Arts* (Attainment Company, 2016), on participants' ability to acquire and maintain targeted vocabulary and comprehension skills. The app incorporated the use of CTD and the system of least prompts when instructing participants on comprehension skills related to: (1) the main character, (2) setting, (3) a three-step sequence of story events, (4) the main idea, (5) problems, (6) solutions, (7) literal recall questions, (8) inference questions, (8) application questions, and (9) questions related to analysis. Results of the study indicated that the four participants involved in the study, all of whom had severe intellectual disabilities, demonstrated improvement in targeted skills based on visual analysis of study data. The use of a digital form of CTD and its positive effect on the acquisition of vocabulary and comprehension skills demonstrate that the intervention can be used not only across academic subjects, but also across instructional formats.

As demonstrated above, CTD has been used across different ages, settings, and skills and, in each study cited, has had a causal effect on desired outcomes. In addition to being effective in teaching vocabulary, comprehension, phonological awareness, and math skills, as previously noted, CTD has also been shown to be particularly effective in the early stages of writing development.

Developmental Stages of Writing

When considering what types of interventions to use when teaching writing to students with IDD, researchers and educators must first have a clear understanding of the stages of writing development in order to support students in acquiring, using, and progressing in the use of writing skills. In the early years, typically from ages 2-7, children progress along the four developmental stages of writing (Bloodgood, 1999; Seemeeu Park Preprimêre Skool, n.d.) (see Figure 14). The first stage, the pre-literate stage, is characterized by the following: (a) scribbling consisting of random and circular markings that have no intended message, (b) symbolic writing including pictures or random marks with an intended message, (c) scribbling from left to right that is linear and has an intended message, and (d) symbolic/mock letters, which resemble letters but lack spacing. In the second stage, or the emergent stage, children progress through: (a) writing a string of letters in random order, (b) grouping letters, including spacing, so groupings begin to resemble words, (c) labeling pictures with the first sound in the name of the picture, and (d) writing and/or copying environmental print, although there may be deviation in size and formation of letters including letter reversals. During the third stage, known as the transitional stage, children begin to: (a) demonstrate letter/word representation by writing the first letter to represent a whole word, (b) use first/last letter representation by including the letters that represent the first and last sounds in words, and (c) include medial letter sounds when attempting to spell words phonetically. The final fluent stage of early writing is the stage in which children begin to be more fluent with writing beginning phrases that represent their writing or thoughts, begin to write sentences, and, finally, begin to use the six traits of writing: conventions, organization, voice, ideas, word choice, and sentence fluency.

In later years, the writing process begins to focus on planning, drafting, revising/editing, proofreading, and publishing one's writings (Evmenova & Regan, 2019; Hayes & Flower, 1986). In addition to this, instruction shifts from writing sentences to writing paragraphs, stories, essays, research papers, and more. Writers begin to focus on specific writing styles such as expository writing in which the author shares information or explains a concepts, narrative writing in which information and a story are being communicated, persuasive writing in which the author focuses on convincing the reader of a position or belief, and descriptive writing in which the author paints a picture of characters, settings, and more with his/her/their words (Open Oregon Educational Resources, n.d.). Historically, students with IDD have been excluded from such instruction (Pennington & Delano, 2012). Today, however, thanks to the passage of IDEA, NCLB and ESSA, this is no longer the case.

Writing and Students with IDD- The Early Years

With the passage of IDEA in 1990, researchers and educators began investigating ways to teach the general education curriculum to students with IDD. While progress was made in the areas of reading (Browder et al., 1990; Rohena-Diaz & Browder, 1996; Heimann et al., 1995; Kamps et al., 1994; Kamps et al., 1999), math (Boyles & Contadino, 1997; Kuluk, 1993; Lueng, 1994; Schloss et al., 1997; Thurlow et al., 1998), and curriculum (Lawrence-Brown, 2000; Olley, 1999; Udvari-Solner & Thousand, 1996), little research was done in the area of writing for students with IDD. In fact, only six studies related to writing and students with autism were completed between 1990, when IDEA was passed, and 2003, the year before IDEA mandated that students with disabilities have access to and make progress in the general education curriculum. Of those six studies, two studies investigated sentence construction (Basil & Reyes, 2003; Yamamoto & Miya, 1999), one explored narrative writing and revision (Bedrosian et al.,

2003), one was related to adjective use (Rousseau et al., 1994), and three evaluated the effect of different intervention packages on spelling (Kinney et al., 2003; Schlosser et al., 1998; Stromer et al., 1996). This meant that until law mandated that educational institutions allow students with IDD access to general education curriculum and held educational institutions accountable for these students' progress within the curriculum, students with IDD were still denied the opportunity to learn to express themselves in writing. This exclusion changed with the passage of the 2004 amendments to the Individuals with Disabilities Education Act.

Writing Challenges Faced by Students with IDD

Given the IDEA mandate that all students with disabilities, including students with IDD, have access to and make progress with the general education curriculum, researchers began to explore curriculum, instruction, and interventions to support students with expensive support needs in writing. While data indicate that writing presents challenges for typically-developing students in the general education curriculum, with only 27% of 8th and 12th grade students scoring in the proficient or advanced range on a national writing assessment (U.S. Department of Education, 2011), researchers have noted that there are unique challenges faced by individuals with IDD. For instance, students with autism often experience difficulty with abstract concepts. such as understanding sarcasm and time, and imagination (Herrera et al., 2006), skills that are often needed for narrative and expository writing. Writing also has a social context, and many people with autism experience difficulty with social communication (Accardo et al., 2020). Taking the perspective of another, an integral part of writing given that one writes for a reader, can be difficult for many writers with autism. Research indicates that while people with autism are able to engage in level 1, or spontaneous, perspective taking, for many the ability to engage in explicit or intentional perspective taking, which is required in writing, is frequently impaired

(Schwartzkopf et al., 2014). In addition to this, research individuals with autism have often demonstrated deficits when filling in missing information or facts for a listener (Jurecic, 2006), or a reader in the case of writing. Spelling, which requires one to encode spoken words and transcribe them into written symbols, has proven difficult for many students with both autism and intellectual disabilities, in particular those who have little or no functional speech (Blischak & Schlosser, 2003). Yet another challenge faced by numerous students with IDD noted by educators and researchers is that sensory preferences and aversions can impact a student's ability to write. Researchers Diamant and Nealon (2018) found a significant correlation between sensory systems and the ability to complete writing tasks such as copying sentences. Given that many students with AU present with a sensory processing disorder (SPD) or characteristics of a SPD, it is not surprising that these students may experience difficulty in the area of written expression. Diamant and Nealon also noted that writers with autism tend to hyperfocus on details of writing, such as writing one letter at a time, without seeing the whole picture. This impacts their ability to see words and sentences as whole concepts and thoughts, which are foundations of writing. Finally, oral language skills build into written language throughout our lives. It is not uncommon for students with AU to have language delays. Given these delays, students with AU also tend to have writings with poorer text quality (Dockrell et al., 2014). All of the aforementioned challenges must be taken into consideration when planning writing instruction and interventions for students with autism.

Students with IDD also may demonstrate deficits, in addition to the ones previously mentioned, that impact their ability to express themselves in writing. First, many students with IDD have deficits in executive functioning (Henry et al., 2010). As a result, they may lack or have a weakness in skills that are necessary for writing. Such skills may include difficulties with

organization and planning, both of which are necessary when gathering one's thoughts for writing and ensuring that events follow a logical order. Many students with IDD may also experience difficulty with working memory which can affect their ability to remain on topic, recall important details, or complete the steps required in the writing processing, all of which impact one's ability to express oneself in written form. While executive functioning impacts the cognitive process of writing, fine motor deficits, which are common in students with IDD such as Down Syndrome (Tsao et al., 2011), also impact one's ability to write. While the use of assistive technology is an option for students who require alternative forms of writing (Pennington et al., 2011; Pennington, 2016), challenges related to access, training, and funding continue to present barriers to written expression for children with IDD. Regardless of the challenges, barriers, deficits, and naysayers, researchers and educators have taken the needs of students with extensive support needs into consideration, along with the mandates of IDEA, and explored, investigated, and found evidence-based practices for teaching students with IDD to write.

Writing and Explicit and Systematic Instruction for Students with IDD

In a quest not only to ensure that students with IDD had access to the general education curriculum and were able to make progress on grade-level content and standards, but also to ensure their unique challenges in writing were taken into account, researchers began investigating evidence-based practices for writing instruction. Given the success of explicit and systematic instruction when teaching daily living skills (Kern et al., 2007; Van Laarhoven & Van Laarhoven-Myers, 2006) and functional academics (Browder & Xin, 1998; Cihak & Grim 2008), researchers began employing them when investigating writing instruction for students with IDD.

Students with IDD often exhibit poor self-regulation, a skill that is necessary for monitoring, instructing, and reinforcing one's own writing behaviors (Graham et al., 2005). Asaro-Saddler and Saddler (2010) were aware of the challenges faced by people with ASD, including understanding abstract concepts, imagination, organizational skills, and elaborating on their own thoughts in written form (Myles et al., 2003), and evaluated the use of self-regulated strategy development (SRSD) and planning on story writing for young students with ASD. According to a meta-analysis done by Graham and Perrin (2007), SRSD yielded the highest average gains in writing over any other strategy or combination of strategies when used with a non-disabled population. What Words Clearinghouse (2017) defines SRSD as a practice that involves a six-step process: (1) the provision of background knowledge, (2) the strategy being used is discussed with students, (3) the strategy is modeled for the students (4) students memorize the strategy, (5) students are supported through guided practice, and (6) students perform the strategy independently. This study extended work previously done by Asaro-Saddler and Saddler (2009) in which the successfully used SRSD to teach planning and story writing to a fourth grade student with ASD.

As that study showed a functional relation between SRSD and an increased number of words, an increased number of story elements the student included in his writing, and an overall improvement in the quality of his writing, Asaro-Saddler and Saddler decided to investigate the effect of SRSD on teaching planning and fictional story writing to young children with ASD who presented with deficits in expressive writing. Using a multiple probes across multiple baseline design across three participants, the 2010 study extended the previous study by: (a) using a larger sample of participants (three participants as opposed to one), (b) the inclusion of a younger population of participants (two second graders and one fourth grader), and (c) examining if

students were able to transfer knowledge about writing stories with fictional characters and pictures to writing a personal narrative given a written prompt. Using the mnemonic devices "POW (**P**ick my ideas, **O**rganize my notes, and **W**rite and say more) and WWW, What = 2, How = 2 (**W**ho are the main characters?, **W**hen does the story take place?, **W**here does the story take place?, **W**hat do the main characters want to do?, **W**hat happens when the main characters try to do it?, **H**ow does the story end?, and **H**ow do the main characters feel?)" (Asaro-Saddler & Saddler, 2010), participants were able to learn the strategies taught and use them in their writings. In addition to this, a functional relation between the intervention package and increased length of participants' writing, improved quality of their writing, increased number of story elements included in their writing, and the ability to transfer strategies taught to personal narratives was established. These results further cemented explicit and systematic instruction as an evidence-based practice (Archer & Hughes, 2010) in writing for students with ASD.

While Asaro-Saddler and Saddler investigated writing instruction for students with autism, Lee et al. (2016) used a multiple probe single-case design across skills to examine writing instruction for students with IDD, still using an explicit and systematic instruction approach. They evaluated the effect of graphic organizers, instruction using task analyses, and the system of least prompts on teaching students with intellectual disabilities to respond to text in written form. This included identifying key ideas in informational texts, completing a graphic organizer with ideas obtained from informational texts, and writing a final product using the graphic organizer and sentence starters. The study included two participants who had intellectual disabilities, attended middle school, and lived in an urban area. Both participants' special education services were delivered in a self-contained classroom and each participated in the alternative assessment. The intervention included a task analysis for each dependent variable

(DV), an informational article, a graphic organizer that included the topic, key details and supporting details, and a writing template that included sentence starters with a repetitive structure for informational writings. Results indicated a functional relation existed between the intervention package and participants' ability to write in response to texts, thus further validating the benefits of SI. The intervention used also addressed challenges identified for many students with IDD through the use of graphic organizers, which supports students who have difficulty with planning, organization, working memory, memory/recall, and hyperfocus. The use of sentence starters further supports students with AU, who often struggle with explicit perspective taking. The inclusion of key and supporting details on the graphic organizer also incorporates many students with autism's strength in attending to details. The implications on writing instruction resulting from this study include that students with IDD are able to identify important information in an informational article and then organize that information in order to compose text related to the article. In addition to this, the study also further validated the use of graphic organizers and writing templates for students who require extensive support in writing.

Specializing in both writing and explicit/systematic instruction for students with extensive support needs, Pennington and Carpenter (2019a) explored current research related to teaching writing to students with autism and complex communication needs. They identified five components that were consistent across the studies they explored and that research indicates are effective in teaching writing to this population. These components included: (1) skills should be taught in a meaningful context, (2) instruction should occur in predictable routines, (3) instruction should be supported by technology, (4) skills should be taught explicitly, and (5) the use of self-management strategies should be employed. By identifying common components in current research, Pennington and Carpenter further cemented the use of explicit, systematic

instruction as a cornerstone not only of academic instruction for students with AU, but, more specifically, a cornerstone for writing instruction for students with IDD.

Writing and Sentence Frames for Students with IDD

Sentence frames are often used in the early stages of sentence writing to teach beginning writers what a sentence is, the components of a sentence, and how to express a complete thought. Sentence frames are a structured, fill-in-the-blank format that is scaffolded to support students in the early stages of writing to respond to a question or a prompt that can be found in many beginning writing programs. The frames are typically used across stimuli with students writing multiple sentences using the same sentence frame and then gradually increase in difficulty with an ultimate goal of students acquiring the ability to write sentences without the use of sentence frames. Ferlazzo and Sypnieski (2018) noted that writing frames provide students with a visual of how words look in context and what is the logical order of words. The use of frames is also beneficial in assisting students in focusing on both key vocabulary and lesson content, as they clarify what is being asked of the student and provide support in making the information more accessible. Given that many students with disabilities find writing challenging, the use of sentence frames can also reduce stress and/or anxiety for inexperienced writers. Sentence frames have been shown to be effective when used in general education (Block, 2020), with English Language Learners (Ferlazzo & Sypnieski, 2018), and with students with disabilities (Lee et al., 2016; Pennington et al., 2018a).

Given that sentences convey information, are used to make requests, and allow a person to share their knowledge, opinions, and needs, having the ability to write sentences not only allows individuals access to written communication and the positive outcomes associated with it, but it also allows them greater control and inclusion in life in general. In their recommendations

for teaching elementary school students to become effective writers, the What Works Clearinghouse (WWC) panel (2018) indicated there was moderate evidence of the effectiveness of sentence frames in teaching sentence construction. The panel recommended the following implementation format: (a) develop a sentence frame appropriate for the writer, (b) model use of the sentence frame, (c) have students use the sentence frame to construct their own sentences, (d) have students share their sentences and discuss the words chosen, and (e) slowly fade the use of sentence frames and transfer control to the students, who begin to write sentences independently.

Given the effectiveness of sentence frames in supporting English Language Learners (ELL) with language development (Hoffman, 2013), enhancing content learning in primary grades (Cudd & Roberts, 1989), and increasing the writing levels and use of content language of ELL students during science lessons (Shimada, 2017), researchers explored the use of sentence frames in teaching writing to students with IDD. Pennington et al. (2018a) used a multiple probe across behaviors design to investigate two intervention packages that included (1) CTD and sentence frames and (2) system of least prompts and sentence frames on the construction of sentence to determine if there was a functional relation between the intervention package and sentence writing for participants with moderate intellectual disabilities who were between the ages of 7 and 12. Two participants used a selection-based writing app to construct sentences, and the third participant generated handwritten responses. Sentences taught included ‘I want ____,’ ‘I see ____,’ and ‘The ____ is ____.’ Although no participants reached criterion on all three sentence formats using the intervention, participants did show increased sentence construction when engaged in requesting activities, which could indicate the need to include activities in which students write to request in the early stages of writing. Further investigation into whether all parts of the intervention packages are needed is recommended by the research team.

In order for students to become strong writers, they must learn to construct sentences that gain the reader's attention and effectively convey meaningful information (WWC, 2018). Sentence frames can assist students in learning content, increasing language skills, focusing on relevant portions of information, organizing their thoughts, and expressing themselves in written form. These are but a few reasons it is imperative that educators explicitly teach sentence writing using evidence-based practices. The use of sentence frames, when paired with response prompting strategies, has been shown to be effective in sentence construction and should be considered when teaching early writing skills to young children and/or struggling writers.

Writing and Constant Time Delay for Students with IDD

CTD, often paired with other strategies such as TAI, has been used to effectively teach students with severe disabilities and verbal difficulties to decode and read consonant-vowel-consonant words (Dean, 2020), academic content in American Government to students with developmental disabilities (Kroesch et al., 2020), vocabulary to young adults with autism and developmental delays (Hua et al., 2013), and leisure skills to high schoolers diagnosed with moderate intellectual disabilities (Seward et al., 2014). In addition to this, CTD, often paired with other systematic instruction strategies, has been effective in teaching writing to students with IDD.

In 2008, using a multiple probe across participants design, Trela conducted a study in which she evaluated the effect of the 'I Write NOW' strategy on the number of components included in a student's opinion writing paragraph in response to an adapted writing prompt. "'I Write NOW' stands for: (a) "**I** think that…", (b) **W**hy do I think that? tell **R**easons, (c) **I**f , (d) **T**hen, (e) **E**xplain, (f) Did you **N**ame your topic?, (g) Did you **O**rder your steps?, and (h) Did you **W**rap it up & re-state topic?" (Trela, 2008). The components evaluated included: (a) number of

correct responses chosen when writing an opinion paragraph, (b) prompts needed to write the opinion paragraph, (c) opportunities for participant to participate in English class with non-disabled peers, (d) how participants' writing prior to and after instruction will be scored on the alternative assessment adapted rubric, and (e) how stakeholders felt the strategy would support participants' access and performance in the general education curriculum and students' educational goals. Three high school students ages 16-20, all of whom had significant cognitive disabilities, participated in the study. Through systematic instruction, supports, and the use of adapted grade-level standards, which fulfilled IDEA's mandate on access to the general education curriculum, participants were taught how to write opinion paragraphs using the 'I Write NOW' strategy. The intervention package included graphic organizers, CTD, and an adapted self-regulated strategy development (SRSD). Results indicate that there was a functional relation between the 'I Write NOW' strategy and the number of correct responses participants chose when writing an opinion paragraph. Results also indicate that all students demonstrated improvement in choosing elements required to write an opinion paragraph. Supporting the needs of students with significant cognitive disabilities, the researcher provided a low tech response mode via response boards that mitigated challenges related to fine motor deficits and access. The provision of graphic organizers and choice responses supported students with executive functioning deficits related to planning, organization, working memory, and memory/recall. By supporting students' in areas that are challenging, the researcher provided the participants with a road to success.

In 2012, Mims et al. increased the rigor in writing expectations for students with moderate and/or severe disabilities by conducting research related to a pilot English/Language Arts curriculum. This was the first study to use a comprehensive approach to teaching students

with moderate and severe disabilities grade-level ELA content. Using a one-group, nonrandomized, pre/post-test design, the study consisted of four parts: unit vocabulary, read aloud and comprehension of text, story elements, and writing. Through the use of grade-level novels and content, the research team investigated the effect of an intervention package that included CTD, graphic organizers, response options that were individualized, and explicit and systematic instruction on targeted grade-aligned ELA skills with a focus on opinion writing in part four. The study included 15 participants of middle school age who had a diagnosis of autism or other developmental disability and received special education services for ELA in a self-contained classroom. During the writing portion of the study, sentence frames were used and individualized response options, which supported students with executive functioning deficits and fine motor delays, were provided. Participants were able to express their opinions through writing, circling a response, cutting and pasting a response, or pointing to their response and having it circled by the interventionist. They began by writing a sentence expressing their opinion about a specified topic, and then wrote a reason(s) to support that opinion. Writers' responses were score as follows: 0- no response, 1- scribbles or points to the page, 2- adds more detail or points to words, and 3- writes or circles correct response. Results of the study indicate partial support of the intervention package, with students' mean scores on correct responses increasing from 38.33% on pretests to 62.47% on post-tests, as only moderate gains were made on the writing portion of the study. As a result of this study, many educators now have greater insight into grade-aligned ELA instruction, including writing instruction, for students with moderate and severe developmental disabilities, including autism.

Although CTD has been demonstrated to be an evidence-based practice for teaching students with IDD (Horn et al., 2020a) and research is available on its effectiveness in teaching

writing, more research is needed in order to expand the professional knowledge base and identify intervention packages that are effective, efficient (Cengher et al., 2018; Knight et al., 2003) and easy for educators to implement in natural settings and routines (Odluyurt, 2011).

Writing and Technology-Aided Instruction for Students with IDD

As with most children, students with IDD tend to enjoy and readily engage in technology-based activities (Saridaki & Mourlas, 2011). This could include playing video games, watching YouTube videos, making TikTok videos, and/or texting with friends. Seeing the power and draw of technology-based activities and the difficulty some students experience with access, attention, engagement, and motivation, researchers began to explore the use of TAI. For the purpose of this thesis, technology-aided instruction is defined as any instruction that involves the use of a computer, tablet, app, and/or digital educational game. In 2003, Basil and Reyes used the Delta Messages software and a scaffolded approach to teach sentence construction through the use of a whole-word selection strategy. Noting that self-initiated learning tasks, self-generated responses, and the 'oops' when students realize their mistakes often lead students to their zone of proximal development (Basil & Reyes, 2003; Tzur & Lambert, 2011), the researchers sought to provide students with an alternate means of writing, as well as an alternate means by which to express themselves. With six participants, three boys and three girls, ages 8.8 to 16.0 who had severe disabilities including autism, intellectual disabilities, and Myotonic Muscular Dystrophy, Basil and Reyes investigated participants' ability to select words and/or word groups, all of which would result in a meaningful sentence. Once the sentence was constructed, it was read aloud digitally, and an animation appeared on the computer screen. Following completion of the sentence, participants were provided with immediate feedback from their teacher. Initial results indicate that the participants' were able to construct sentences

consisting of three grammatical elements including a subject, verb, and object. For example, "The boy kicked the ball." Final results indicate a significant improvement, as participants were able to construct sentences consisting of seven elements such as, "The boy kicked the red ball over the fence and broke the window." Self-direction during the intervention, which included choosing the course of one's writing, setting one's own pace, and receiving feedback on one's self-produced works, as opposed to having set answers during the testing phase, was indicative of a positive effect. Another positive outcome of the study was seen in the increased ability of participants to synthesize and spell words that were not part of the study vocabulary. Participants maintained their writing skills and showed increased interest in writing following inclusion in the study. Self-direction, self-expression, maintenance, and increased interest in writing helped establish TAI as an evidence-based practice.

Other technology-aided interventions such as video modeling and video self-modeling have been shown to be effective in teaching children with ASD social-communication skills, functional skills, and behavioral skills (Bellini & Akulian, 2007), as well as academics (Burton et al., 2013; Prater et al., 2012). In 2007, Delano extended the use of technology for writing instruction to include video. In particular, she investigated the use of SRSD, which was presented to participants via video self-modeling, on participants' ability to write a persuasive paragraph. Participants' writings were scored based on rate of words written and rate of functional essay elements. Using the power of observational learning and participants seeing themselves performing the desired behaviors, Delano implemented the intervention with three males with a diagnosis of autism who were ages 13-17. Participants were given a persuasive writing prompt in which they were tasked with writing to persuade the reader to agree with them. Participants were also given expository tasks in which they were to explain how or why

something happened. Each participant created a video in which they employed a self-monitoring writing strategy. Prior to intervention sessions, the participants viewed their self-monitoring video and were then directed to employ the strategies seen. Once participants showed a 10% increase in the number of written words across three data sessions, the participant ceased watching the video. A second skill, functional essay elements, was also taught using video self-modeling. Participants modeled and then used an SRSD strategy, use of the mnemonic TREE, which stands for topic, reasons, explain each reason, and ending, as part of the intervention. Results of the study indicate that when using SRSD to teach functional essay elements participants showed an increase in the average number of words written. While more research needs to be done, this increase suggests that interventions focused on functional essay elements may result in increased words written. The use of video self-modeling strengthened practices in writing instruction for students with extensive support needs and further disproved the prior notion that students with IDD lacked the ability to write.

Through the use of a multiple baseline across participants design, Pennington et al. (2011) increased the rigor of writing instruction for students with autism when they explored the effect of simultaneous prompting and computer-assisted instruction on story-writing. Three male participants who were between the ages of 7 and 10 were taught to write a story comprised of four sentences in a predetermined order. The first sentence stated the character of the story, followed by a second sentence stating the setting. In the third sentence, participants wrote about an action the character engaged in, and finally, in the fourth sentence, an action or consequence of the first action was described. Results of the study showed a functional relation between the independent and dependent variables, as all participants demonstrated improvement in their ability to construct computer-based stories. In addition, two participants demonstrated both

maintenance and generalization using new story templates and response options. Two participants were also able to generalize results to vocal responses, which was not a targeted skill. When asked to tell the teacher a story, one participant produced 16 words, while the other student produced 41. This study not only indicates the effectiveness of simultaneous prompting and computer-aided instruction in teaching writing to students with autism, it also indicates that the intervention may be effective in teaching storytelling using vocal responses. Pennington et al.'s work related to story writing further pushed the boundaries of what we could expect of students with extensive support needs when provided with explicit and systematic instruction that incorporated evidence-based practices.

The ability to use technology has, over time, increasingly become a vital part of not only one's success in school, but also in life in general (WWC, 2018). Following a review of 29 studies in peer-reviewed articles on the use of computers and other technologies used in writing instruction, it was noted that the use of TAI has resulted in improved composition in students' writings, provided students' with alternative modes of accessing writing, increased student participation and engagement, increased social interactions among peers, and increased collaboration among writers (Williams & Beam, 2019). Given the positive outcomes of TAI embedded in writing instruction, it is an intervention that is ripe for exploration of best practices in teaching writing to students with disabilities.

Writing, Explicit and Systematic Instruction, Constant Time Delay, Sentence Frames, and Technology-Aided Instruction for Students with IDD

Understanding the developmental stages of writing and the fact that, given lack of opportunity, many students with IDD require instruction on early writing skills, Canella-Malone et al. (2015) developed a system of instruction to teach written expression to students with

intellectual disabilities who were of school age using the mnemonic ACCESS, which stands for: (a) accommodations and assistive technology, (b) concrete topics, (c) critical skills, (d) explicit instruction, (e) strategy instruction, and (f) systematic evaluation. Accommodating students' individual needs, including the need for assistive technology, providing alternate response forms, teaching reading and writing skills simultaneously, and providing support for sentence construction using sentence frames and graphic organizers for organization and planning ensure access for all writers. Providing concrete topics and experiences supports students' understanding and provides context. Addressing critical skills, such as writing for both academic and real life purposes, writing to gain access, and understanding that writing is a way to affect others, are essential in order for students to progress in their writing abilities. As with all instruction, explicit instruction is a vital part of any good writing program and should be based on the use of evidence-based practices such as CTD, system of least promptings, and simultaneous prompting, all of which have resulted in positive writing outcomes. Strategy instruction, such as SRSD, which contains more than 70% of the WWC recommendations for effective writing instruction for young writers (WWC, 2018), even when modified for students with IDD, not only has positive effects on writing content, but also on the quality of students' writings. Finally, systematic evaluation, such as the use of task analyses for data collection and rubrics for measures of achievement and progress, ensure that students' skills are accurately assessed and educators are able to make data-based decisions regarding students' writing instruction. When the components noted in the ACCESS strategy are incorporated into writing instruction and routines, positive outcomes can be anticipated.

Writing, Explicit and Systematic Instruction, Constant Time Delay, Sentence Frames, and Technology-Aided Instruction Embedded in a Story-Based Lesson

According to WWC (2018), writing instruction for students in lower grades and those who struggle with writing should focus on learning sentence patterns and/or substituting words in sentences in the appropriate place, such as those taught through the use of sentence frames. WWC further indicates that instruction should include the student reading a story, or having a story read to him/her/them, followed by completion of a story frame to match the story. Following the recommendations of WWC and building on previous research done by researchers such as Pennington, Mims, Delano, and others, the study outlined in this thesis sought to add to the professional literature on writing instruction for students with IDD by answering the following questions: (1) What is the effect of an intervention package that includes CTD and sentence frames on correct word selection for sentences constructed using TAI during a story-based lesson?, (2) What is the effect of an intervention package that includes CTD and sentence frames on correct word selection for a summary constructed using TAI after a story-based lesson?, and (3) What are the stakeholders' perceptions of the targeted intervention and outcomes?

Chapter 3. Methods

Participants

The participants in the study included four elementary school students in first and second grades. Each of the participants received special education services in a public Title 1 elementary school via an IEP under IDEA in both the general education classroom and an Extended Resource classroom. All targeted students met the inclusion criteria for participation in the study which included the following: (a) has a developmental delay, intellectual disability, and/or autism, (b) able to touch a single cell on an iPad to activate an action, (c) able to swipe to move a single cell on an iPad to a designated location, (d) able to attend to a SBL until completion of the lesson, (e) able to visually attend to illustrations in a storybook, (f) has no prior experience with the construction of sentences, (g) has ability to match to sample after a model prompt (model prompt is the controlling prompt), and (h) receives special education services through the Extended Resource program. Possible participants were excluded from the study if they did not meet the aforementioned criteria. The researcher conducted a records review to ensure participants had a diagnosed IDD, a criteria for participation in the study, to verify participants' age, grade, and IQ if available, and to review assessment and eligibility information relevant to meeting the needs of study participants.

Parent/Guardian permission was obtained for all participants prior to the beginning of the study, and parents/guardians were informed that they could withdraw their child from the study at any time without explanation. Participants chose their own pseudonyms for use throughout the study; however, all participants requested that the pseudonyms not be used during study sessions. In order to honor the requests and self-advocacy of participants and maintain

confidentiality, the general term ‘friend’ was used when referring to participants during study sessions.

Participant One: Princess

Princess, who was 6-years old and in first grade, was a White female who received special education services under the category of a developmental delay. Princess’ most recent evaluation included a developmental medical history in which her mother noted that she was born with the umbilical cord wrapped around her neck and that she lost oxygen at birth. She received genetic testing at 14 months of age with no definitive findings for the etiology of her delays. It was noted that Princess had sensory aversions with her hands and feet, and that she has been diagnosed with secondary carnitine deficiency for which she takes a carnitine supplement. Per the results of the Developmental Assessment of Young Children- Second Edition (DAYC-2), Princess received a standard score (SS) of 62 (mean 100) in the communication domain, *h*aving scored 57 (SS) in receptive language and 72 (SS) in expressive language. As a result, Princess received speech and language services. The results of the DAYC-2 also indicated standard scores of 65 in the cognitive domain (very poor range or first percentile), 69 in the social/emotional domain (very poor range or second percentile), and 62 in the adaptive behavior domain (very poor range or first percentile). Evaluations by an occupational therapist (OT) indicated fine and visual motor delays and hypersensitivities to sound and tactile input. Princess received OT services weekly to address these delays and sensory needs. While standard scores were not obtained, it was noted that Princess had gross motor delays and qualified for physical therapy in the school setting. Finally, Princess had a behavior intervention plan to address her deficits with self-regulation.

To support her academic and behavioral needs, Princess received services in an Extended Resource classroom for approximately 66% of her school day. Her IEP included the following goals related to writing: (a) 'Given a topic of study, a model, and explicit directions, Princess will express her knowledge using drawing, imaginative writing, graphic organizers, worksheets, etc. in 4 out of 5 trials over 4 consecutive data sessions as measured by classroom staff using data collection, work samples, and/or informal assessments,' (b) 'Given a home, school, or community event, a model, and explicit directions, Princess will express her opinion using drawing, imaginative writing, graphic organizers, worksheets, etc. in 4 out of 5 trials over 4 consecutive data sessions as measured by classroom staff using data collection, work samples, and/or informal assessments,' (c) 'By the end of the IEP period, Princess will write her name by imitating the formation of each letter when given a demonstration of each letter one at a time with recognizable letter forms of each letter on 3/5 consecutive trials,' (OT goal), and (d) 'By the end of the IEP period, Princess will imitate the formation of at least 13 capital letters with recognizable letter forms after a demonstration on 3/5 consecutive trials.' (OT goal). Per an interview with her OT, Princess was able to trace her name and write recognizable approximations of the letters in her name with deviation in formation and size. Princess had excellent attendance; her hearing was within normal limits; and she wore glasses to correct her vision, although her glasses were broken during the study and were not replaced within the lifetime of her intervention phase. Being without her glasses did not impact her ability to participate, as she was able to see all materials used including vocabulary words, text, illustrations, and words on the Clicker Writer app. Princess displayed mild to severe dysregulation related to not obtaining desired activities or attention multiple times per day and had IEP goals and a behavior intervention plan to address self-regulation. Given her high levels

of engagement and expressed pleasure at engaging in one-on-one activities with the interventionist, Princess did not experience dysregulation during any of her intervention sessions, although she did experience episodes of severe dysregulation during her second generalization probe and when it was another participant's turn for intervention, even when prepared the day before and the morning of a new participant's sessions (see Table 1 for participant summary).

Participant Two: Thanos

Thanos, who was 7-years old and in first grade, was a White male who received special education services under the category of autism. Thanos' most recent evaluation indicated that he had an IQ composite of 81, a verbal SS of 84, and a nonverbal SS of 83. During a classroom-based observation and via teacher questionnaire, it was noted that Thanos was significantly behind his same-age peers academically, and that he struggled with self-regulation, social interactions with peers, transitions, and transitioning from a preferred activity. Thanos often refused to comply with teacher directions and classroom expectations, in particular when activities involved writing or prevented him from engaging in preferred activities. The Kaufman Test of Educational Achievement- Third Edition (KTEA-3) was used to assess Thanos' abilities in reading, math, written language, and oral language. His scores ranged between a SS of 40 in written expression (very low range) and a SS of 90 in letter and word recognition (average range). Most scores fell within a SS of 51-68, or a very low to low range, although skills related to reading fell within the below average range. Thanos received a written language composite SS of 49, which is in the very low range. During his speech evaluation, it was noted that Thanos' spoken language was 45% intelligible when the topic was known but no gestures were used and 55% intelligible when the topic was known and gestures were used. Using the receptive portion of the Receptive, Expressive & Social Communication Assessment- Elementary (RESCA-E),

Thanos received a SS of 85 (16th percentile) in receptive core language and a SS of 80 (9th percentile) in social communication core language. The evaluator noted that scores should be viewed with caution because it was hard to get an accurate measure due to Thanos' intelligibility and refusals. Thanos was also evaluated using the Sensory Processing Measure Home and Main Classroom (MC). His total sensory systems (TOT) scale was 52 at home, indicating typical responses, and 71 at school, indicating a definite dysfunction.

To support his academic and behavioral needs, Thanos received services in an Extended Resource classroom for approximately 60% of his school day. His IEP included the following goals related to writing: (a) 'Given a topic of study or a story/information text that has been read aloud, Thanos will express his knowledge using charts, graphs, drawings, worksheets, writings, and/or dictation to scribe followed by copying from a model in 8 out of 10 opportunities over 4 consecutive data sessions by the end of the IEP as measured by classroom staff using student work samples, data collection, and/or structured observation with anecdotal reports,' (b) 'Given a topic of study, a story that has been read aloud, or an event, Thanos will express his opinion using charts, graphs, drawings, worksheets, writings, and/or dictation to scribe followed by copying from a model in 8 out of 10 opportunities over 4 consecutive data sessions by the end of the IEP as measured by classroom staff using student work samples, data collection, and/or structured observation with anecdotal reports,' and (c) 'Thanos will copy the lowercase letters with fair legibility with 75% accuracy over 3/5 consecutive trials by the end of the IEP period,' (OT goal). Per an interview with his occupational therapist, although Thanos had an OT goal for writing lowercase letters, given his difficulty with the mechanics and processes related to handwriting due to apraxia, he was only able to write poor approximations (major deviation in formation and size, not recognizable by unfamiliar instructor) of 3 letters in his name. As a result

of his success during this study, the occupational therapist is now doing trial runs with technology-based writing formats. Thanos had good attendance, and his hearing and vision were within normal range (see Table 1 for participant summary).

Participant Three: Unicorn

Unicorn, who was 8-years old and in second grade, was a White female who received special education services under the category of autism. Unicorn's most recent evaluation indicated that, according to the Stanford-Binet Intelligence Scales- Fifth Edition (SB-5), she had a full scale IQ of 50 (moderately delayed) and an extended IQ of 25 (profoundly delayed). She received a verbal score of 55 (mildly delayed) and a nonverbal score of 49 (moderately delayed). Per the STAR 360 Early Literacy Screening assessment, Unicorn scored 370 which falls in the 3rd percentile. Classroom-based assessments indicated that Unicorn showed a significant delay in academic skills when compared to her same-age peers. Per the Wechsler Individual Achievement Test – Third Edition (WIAT-III), Unicorn received a SS of 53 in oral expression (very low), a SS of 45 in math problem solving (very low), a SS of 62 in early reading skills (low), a SS of 68 in alphabet writing fluency (very low), and a SS of 67 in spelling (low). Deficits in self-regulation, following directions and expectations, transitioning from a preferred activity, attention to safety, and social interaction were noted both at school and at home, as indicated via parent and teacher questionnaire, as were engagement in repetitive behaviors and restrictive interests. Unicorn had a behavior intervention plan to address both safety and noncompliance, although the plan was discontinued due to progress made with self-regulation. Using a battery of tests that included the Peabody Picture Vocabulary Test, Fourth Edition (PPVT-4), Preschool Language Scales, Fifth Edition (PLS-5), Boehm Test of Basic Concepts, Third Edition (Boehm-3), and Clinical Assessment of Articulation and Phonology, Second Edition (CAAP-2), it was determined that

Unicorn demonstrated delays in expressive, receptive, pragmatic, and functional use of language. As a result, Unicorn received speech and language services. It was also noted that Unicorn received minimal special education and no related services during the preceding pandemic school year per parent choice.

To support her academic and behavioral needs, Unicorn received services in an Extended Resource classroom for approximately 60% of her school day. Her IEP included the following goals related to writing: (a) 'Given a topic of study or a story/information text that has been read aloud, Unicorn will express her opinion using charts, graphs, drawings, worksheets and/or dictation to scribe followed by copying from a model in 8 out of 10 opportunities over 4 consecutive data sessions by the end of the IEP as measured by classroom staff using student work samples, data collection, and/or structured observation with anecdotal reports,' and (b) 'Given a topic of study or a story/information text that has been read aloud, Unicorn will express her knowledge using charts, graphs, drawings, worksheets and/or dictation to scribe followed by copying from a model in 8 out of 10 opportunities over 4 consecutive data sessions by the end of the IEP as measured by classroom staff using student work samples, data collection, and/or structured observation with anecdotal reports.' Per classroom staff, given a model and visual/verbal prompts, Unicorn was able to copy letters and single words with deviation in formation and size of letters. Unicorn had excellent attendance, and her hearing and vision were within normal limits (see Table 1 for participant summary).

Participant Four: Sonic

Sonic, who was 6-years old and in first grade, was a Native American male who received special education services under the category of developmental delay. Sonic's most recent evaluation indicated that the Autism Diagnostic Observation Schedule - Second Edition (ADOS-

2) was completed by the school psychologist and the one-on-one paraprofessional working with Sonic. Sonic's performance during the assessment was consistent with a classification of autism with a moderate level of autism spectrum-related symptoms. However, when the Behavior Assessment System for Children- Third Edition (BASC-3) was completed, there was a significant disparity between Sonic's parent's scores and the scores of his teacher. The teacher's scores fell in the at-risk to extremely elevated range, with the majority of scores falling in the clinically significant range, while Sonic's mother's scores fell within the normal to at-risk range. Using the Preschool Language Scale- Fifth Edition (PLS-5) to assess his communication skills, Sonic received a SS of 53 in auditory comprehension, a SS of 66 in expressive communication, and a total language standard score of 56; thus, he qualified for speech and language services. Finally, using the Battelle Developmental Inventory- Second Edition (BDI-2), Sonic received a SS of 50 in the cognitive domain, with a score of 85-115 being the average range, indicating his cognitive abilities were significantly below average when compared to his same-age peers.

To support his academic and behavioral needs, Sonic received services in an Extended Resource classroom for approximately 60% of his school day. His IEP included the following goals related to writing: : (a) 'Given a topic of study or a story/information text that has been read aloud, Sonic will express his knowledge using charts, graphs, drawings, worksheets, writings, and/or dictation to scribe followed by copying from a model in 8 out of 10 opportunities over 4 consecutive data sessions by the end of the IEP as measured by classroom staff using student work samples, data collection, and/or structured observation with anecdotal reports,' (b) 'Given a topic of study, a story that has been read aloud, or an event, Sonic will express his opinion using charts, graphs, drawings, worksheets, writings, and/or dictation to scribe followed by copying from a model in 8 out of 10 opportunities over 4 consecutive data sessions by the end of the IEP

as measured by classroom staff using student work samples, data collection, and/or structured observation with anecdotal reports,' and (c) 'Given pictures he has drawn, pictures related to a topic of study, and/or objects in the environment, Sonic will write to label pictures and objects in 8 out of 10 opportunities over 4 consecutive data sessions by the end of the IEP as measured by classroom staff using student work samples, data collection, and/or structured observation with anecdotal reports.' Per an interview with classroom staff, it was noted that, given a model, Sonic was able to copy letters and single words with deviation in formation and size of letters. Sonic had poor attendance, having missed one-third of the school year, and his hearing and vision were within normal limits. Sonic had a behavior intervention plan when the study began; however, it was discontinued mid-study due to progress with the identification and use of self-regulating strategies. See Table 1 for participant summary.

Table 1

Participant Information

Participant Name	Age/ Grade	Ethnicity	Disability	Assessment and/or Relevant Information	Writing Abilities per OT/Classroom Staff Report
Princess	6 years old, first grade	White	Developmental Delay	* DAYC-2: Communication- SS 62 Cognitive- SS 65 Social/Emotional- SS 69 Adaptive Behavior- SS 62 * Hypersensitivities to sound and tactile input * Received OT, PT, and Speech services	Able to trace her name and write recognizable approximations of the letters in her name with deviation in formation and size

				* Had a behavior intervention plan and IEP goals to address self-regulation	
Thanos	7 years old, first grade	White	Autism	* KBIT-2: IQ Composite- SS 81 Verbal- SS 84 Nonverbal- SS 83 * KTEA-3: Written Expression- SS 40 Written Language Composite- SS 49 * Speech was intelligible 45%-55% of time when the topic was known. * Received OT and Speech services * Presented with sensory systems dysfunction * Engaged in escape behaviors and emotional dysregulation related to academic activities involving writing	Able to write poor approximations (major deviation in formation and size, not recognizable by unfamiliar instructor) of 3 letters in his name
Unicorn	8 years old, second grade	White	Autism	* SB-5: Full Scale IQ- 50 Verbal- 49 Nonverbal- 55 * WIAT-III: Oral Expression- SS53	Given a model and visual/verbal prompts, was able to copy letters and single words with deviation in formation and size of letters

				Early Reading Skills- SS62 Alphabet Writing Fluency- SS68 Spelling- SS67 * Received Speech services	
Sonic	6 years old, first grade	Native American	Developmental Delay	* ADOS-2: Moderate level of autism * BASC-3: Discrepancies between parent and teacher scoring. Scores ranged from no elevation to extremely elevated * BDI- 2: Cognitive domain- SS50 * Received Speech services * Engaged in escape behaviors and experienced emotional dysregulation related to tasks he perceived to be difficult, error correction, and engaging in non-preferred activities * IEP goals addressed self-regulation	Given a model, was able to copy letters and single words with deviation in formation and size of letters

Interventionist

The researcher served as the interventionist and primary data collector. She was a National Board Certified Teacher with 31 years of experience as a special education teacher, of which 19 years were spent teaching students in kindergarten through second grade with intellectual disabilities, developmental delays, and autism. She held a Class 1 Professional Teaching License in special education for preschool through twelfth grade. She was seeking a Master's degree in Advanced Studies in Special Education (research track) and was trained in the use of CTD and sentence frames and teaching SBL, all of which she had used for over 12 years. In addition to this, the interventionist has taught workshops and professional development trainings on the use of evidence-based practices, including CTD, and SBL to educators of students with intellectual disabilities, developmental delays, and autism.

Setting

The study, including baseline, intervention, generalization, and maintenance phases, took place in an Extended Resource class located in a public Title 1 elementary school serving approximately 450 students in a rural state in the Northwest United States. The school demographics were as follows: white- 81.4%, American Indian- 10%, Hispanic- 5.8%, African American- 1.6%, Asian- 0.9%, and two or more races- 0.2% (Retracted School, 2021). The school housed one of four Extended Resource programs in a district of eight elementary schools. The Extended Resource program consisted of a lower elementary class for students in kindergarten through second grade and a secondary class for students in third through fifth grade. See Table 2 for school demographic information.

Table 2

School Demographics (website link retracted to preserve confidentiality of participants)

Race	Percent
White	81.4%
African-American	1.6%
Asian	.9%
Hispanic	5.8%
American Indian	10%
Pacific Islander	0%
Two or More Races	0.2%
Other Information	
Free/Reduced Lunch	26.7%
Student/Teacher Ratio	14:1
Math Proficiency (grades 3-5)	72%
Reading Proficiency (grades 3-5)	67%

Classroom Set-Up

The Extended Resource classroom consisted of ten students who were served in both the special education and general education settings by one classroom teacher, who was in her final semester of a Master's program in special education, and four paraprofessionals who had 1, 4, 26, and 28 years of experience in a special education setting. Students in the class exhibited a variety of ability levels with all students requiring an adapted general education curriculum. The classroom consisted of three separate instructional areas that were divided by shelves to diminish distractions, a bathroom, and a break room, which was being used as a fourth instructional area

due to COVID restrictions. Study participants' daily literacy group instruction took place in 'Level 3', the same instructional area used during study sessions unless there was a need for a classroom schedule change, which resulted in participants' literacy group taking place in 'Level 2', the site of their natural reading instruction, to accommodate nonparticipants' instructional needs.

Intervention Instructional Area Set-Up

Intervention sessions were conducted during study participants' regularly scheduled literacy time in the Extended Resource classroom. Since intervention sessions were conducted in the participants' natural classroom environment and during the natural classroom schedule, other study participants were in the same instructional area as those participating in intervention. Participants not engaged in study intervention sessions worked on literacy or reading instruction via online apps on iPads and Chromebooks. These participants were faced away from the intervention instructional area and wore headphones with devices turned up to the highest safe and comfortable volume to prevent participants from observing or hearing intervention implementation for other participants. Additionally, multiple instructional groups occurred in the classroom simultaneously, which assisted in preventing other participants from overhearing intervention implementation. Participants in intervention chose their seating from an array of options and were seated at a table beside the researcher. Instruction was carried out one-on-one by the researcher, who also served as the classroom teacher, while the other students in the class were being instructed by paraprofessionals.

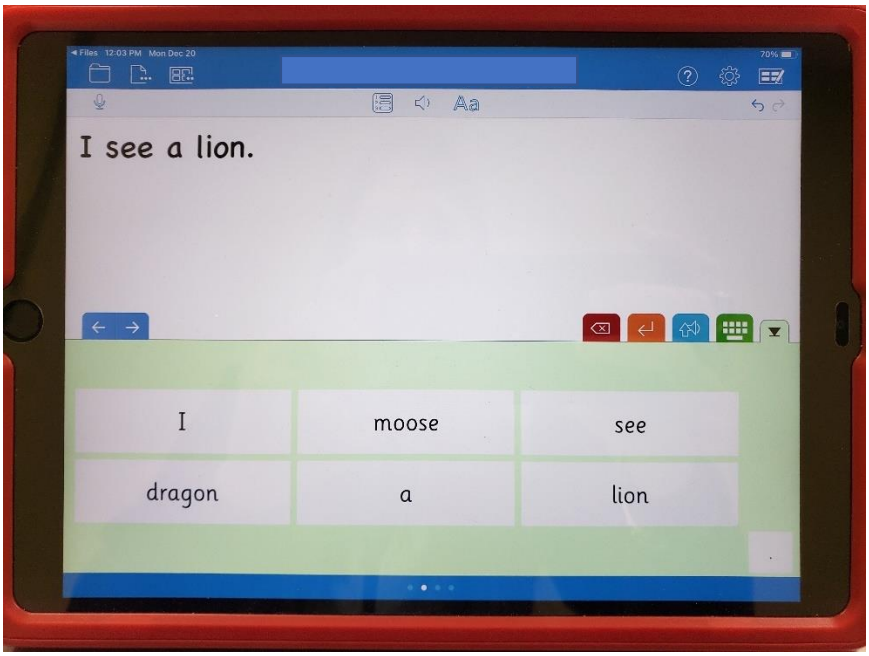
Materials

During the study, participants used an iPad (8th generation) containing the Clicker Writer app by Crick Software US (https://www.cricksoft.com/us/clicker/apps), a simple word processor

that enables users to write using whole words and/or phrases through the use of word banks in which answer choices are arranged in single grids (see Figure 1). The app provides the option of adding picture supports to sentences and/or individual words, although no picture supports were used for this study. Clicker Writer can also be programmed so that users are able to hear the word selections prior to choosing them, and sentences can be read aloud once completed, which enables users to identify mistakes. The researcher did not use the feature allowing participants to hear a word prior to choosing it for this study; however, participants responses were read aloud if they employed use of the period (.) on the Clicker Writer app.

Figure 1

Clicker Writer App



During zero-second time delay trials, or the initial instructional phase of three days, participants were presented with a model of the targeted sentence. Model sentences were printed in black on 5.5” x 6.0” pieces of white cardstock using a 48-point Comic Sans font. Double spaces were placed between each word in the sentences (see Figure 2) as a visual support.

During intervention phases, or five-second time delay trials, model sentences were printed on the same 5.5” x 6.0” cardstock; however, flaps were fastened above each word in the sentences. These flaps were made by folding the white cardstock and cutting it to cover each individual word; poster tack was then used to affix the flaps to the cards so the researcher was able to lift the flap. The flaps were used so that only the current word being focused on for writing was visible (see Figure 3). They also prevented participants from seeing other words in the sentences.

Figure 2

Baseline Model Sentence Example

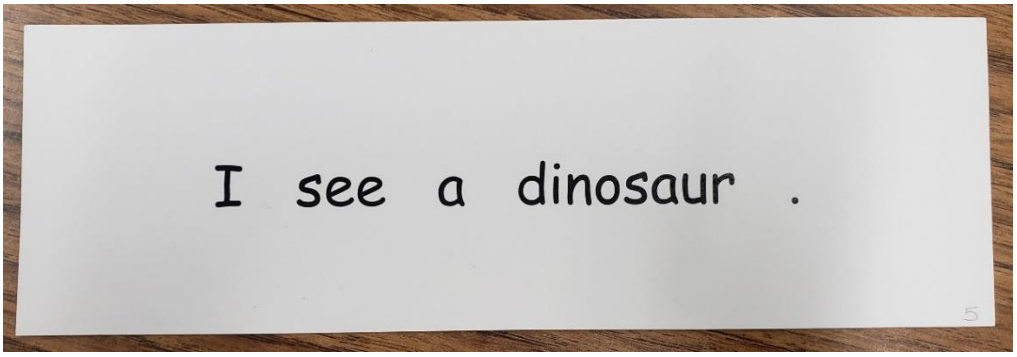
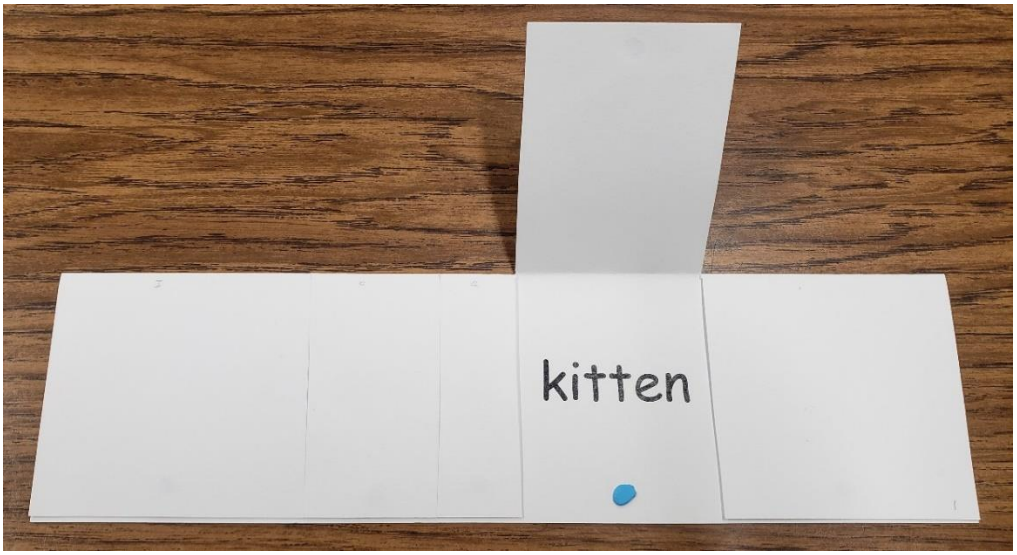


Figure 3

Intervention Model Sentences with Flaps Example



Picture books chosen for SBL were appropriate for students in first and second grades with an average Lexile level of 492, were between 26 and 32 pages in length, and were able to be read in one session, which lasted between 19 and 27 minutes depending on the participant and length of the text. In order to ensure consistency across all books chosen, a content expert was consulted regarding the books used across phases to ensure consistency in the complexity of the texts so as to avoid text complexity being a confounding variable. The expert used the Lexile level for each book to evaluate the complexity of the text. All books selected had a Lexile level range of 410-550 (see Table 3).

Table 3

Storybooks Used: Title, Author, Lexile, and Number of Pages

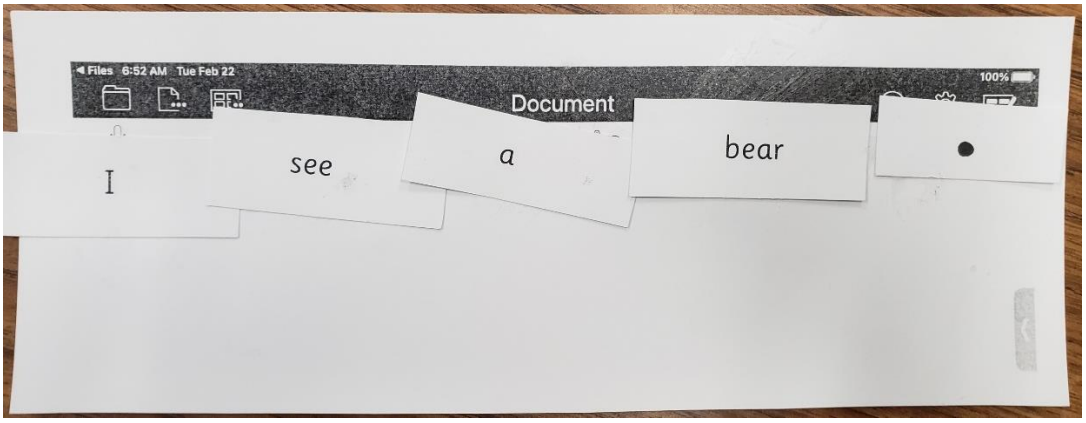
Session	Title	Lexile Level	Number of Pages
Baseline 1-1	The First Strawberries retold by Joseph Bruchac	550	29
Baseline 1-2	The Kissing Hand by Audrey Penn	520	27
Baseline 1-3	Dot & Jabber and the Great Acorn Mystery by Ellen Stoll Walsh	480	28
Baseline 1-4	Look Out Kindergarten, Here I Come! by Nancy Carlson	490	29
Baseline 1-5	Philomena's New Glasses by Brenna Maloney	490	31
Probe 1	Harold and the Purple Crayon: Harold Finds a Friend Text by Liza Baker	530	32
Baseline 1-2	Clifford's Kitten by Norman Bridwell	410	30
Baseline 2-2	Dinosaurumpus by Tony Mitton	430	29
Baseline 2-3	Where's My Teddy? by Jez Alborough	460	26
Intervention 1	Block City by Robert Louis Stevenson	520	29
Intervention 2	Clifford Goes to Kindergarten by Norman Bridwell	520	30
Intervention 3	BigMama's by Donald Crews	550	30
Intervention 4	Have You Got My Purr? by Judy West	510	26
Intervention 5	Huggapotamus by Steve Metzger	520	30
Intervention 6	Dixie Loves School Pet Day by Grace Gilman	470	28
Intervention 7	If You Give a Mouse a Cookie by Laura Numeroff	410	28

Intervention 8	Llama Red Pajama by Anna Dewdney	420	29
Intervention 9	Pete the Cat: I Love My White Shoes by Eric Litwin	460	31
Intervention 10	Lily's Cat Mask by Julie Fortenbury	500	30
Intervention 11	Sammy and the Dinosaurs by Ian Whybrow	520	26
Intervention 12	Daniel's Good Day by Micha Archer	480	30
Intervention 13	Clark the Shark by Bruce Hale	500	30
Generalization 1	National Geographic Kids: Spiders	500	32
Generalization 2	The Rabbit Listened by	450	32
Generalization 3	Dixie and the Class Treat by Grace Gilman	470	32
Maintenance 1	How Do Dinosaurs Go to School? by	510	32
Maintenance 2	Hungry Harry by	520	26
Maintenance 3	Mean Soup by	430	32

Due to low student attendance resulting from COVID-related absences, three generalization probes were conducted with two participants as opposed to two, as originally planned. The third generalization probe measured participants' ability to construct sentences across response modes by gluing word selections to construct sentences. Response choices were created via screenshots from the Clicker Writer app that were printed on cardstock, cut into single words, and placed in random order (see Figure 4).

Figure 4

Third Generalization Probe Materials Example



Experimental Design

The design of this study was a quasi-experimental single-case research multiple probe across participants design. Single-case designs involve an independent variable (IV) that is systematically manipulated (WWC, 2010), data are collected repeatedly in order to show a functional relation between the IV and DV or outcome, and participants serve as their own control (Lobo et al., 2017). Specifically, a multiple probe across participants design (Ledford & Gast, 2018) was used to evaluate the effect of an intervention package that included CTD and sentence frames on correct word selection for sentence construction using TAI. Prior to beginning intervention, five baseline probes were conducted for all participants except Thanos, who, due to absences related to COVID, had four baseline probes. There was no variability, and data were low and stable with all participants scoring 0% on all baseline probes. Following baseline, the intervention was introduced to the first participant, Princess. Once the data of the first participant showed a therapeutic effect, e.g. showed a positive trend and stability, the interventionist probed all remaining participants. Given that all participants' data remained flatlined at zero on correct sentences constructed, and given that Thanos was able to identify study vocabulary needed to construct sentences taught with 100% accuracy on three probes prior to intervention, only one additional baseline probe was done before he entered intervention (Kratochwill et al., 2021). However, prior to the other two participants entering intervention, both of whom showed variability in their ability to identify study vocabulary with scores ranging from 20-40% correct word selection, and according to the recommendations of WWC (WWC, 2021), three additional baseline points were taken prior to entering their respective tiers. Once the data of the second participant reached a therapeutic effect, e.g. showed a positive trend and stability, the interventionist probed all remaining participants to ensure data were low and stable

before introducing the intervention to the third participant. Given that data remained low and stable at zero, Sonic was introduced into intervention next. Due to the fact that a therapeutic effect had been demonstrated with Thanos and because the researcher had a limited trial period with the Clicker Writer app, Unicorn, the fourth participant, was introduced into intervention one day after Sonic. Following three days of zero-second time delay, Sonic had COVID-related absences which resulted in Unicorn becoming participant number three and Sonic moving to the fourth tier. Upon his return to school, Sonic joined Unicorn in intervention.

The researcher conducted a visual analysis (Lane & Gast, 2014) of data each day following intervention sessions. The researcher analyzed the data to determine the immediacy of effect, magnitude, level, and trend with which the DV changed. Additionally, the researcher visually analyzed for overlapping data between adjacent conditions to determine if a change in the DV occurred across participants, to check for variability, to look for trends across and within conditions, and to determine if modifications to the treatment package needed to be made.

Dependent Variable

The primary DV in this study was correct word selection for sentences that participants construct using TAI during a SBL. The secondary DV was the construction of a summary sentence containing the correct word selection using TAI, which participants write following a SBL. Data on the percentage of correct word selection for sentences constructed were collected on both the primary and secondary DV three times per week during participants' regularly scheduled literacy instruction.

Independent Variable

The IV in this study was constant time delay and sentence frames, which were used to teach correct word selection to construct sentences using TAI during a SBL. The interventionist

conducted two rounds of time delay per participant, a zero-second time delay round, which lasted for three sessions, and a five-second time delay round during all other intervention sessions.

Data Collection and Analysis. Sentences were scored based on correct word sequence selected, also known as correct syntax. A correct sentence was defined as a sentence that contained the words of a grade-level sentence template, or sentence frame, that were in the correct word order. Each sentence in the primary DV (i.e., I see a ____.) had a total of five possible points. This included one point for each correct word selection in the correct order and for placing a period at the end of the sentence. Given that the participants wrote this sentence at three different points during the SBL, there were a total of 15 possible points per session for the primary DV. The summary sentence, or the secondary DV (i.e., I read about a ____.), had a total of six possible points per session. During all phases, a correct response was coded with a check, and an incorrect or no response was coded with a "-". The number of correct responses was divided by the total number of possible correct responses and multiplied by 100 to calculate a percentage correct for each session. The interventionist collected data using a repeated trial data sheet (see Figure 5), session data were analyzed, a percentage correct per session was calculated, and the session percentage was graphed daily following each data session.

Figure 5

Study Data Sheet: Baseline, Intervention, and Probes

Correct Word Selection Data Collection

Data will be graphed daily.

Participant Pseudonym: _____ Date: _____ Session Number: _____

Book: _____

Word Selection	I	see	a	(object)	.	Total
Sentence 1						
Sentence 2						
Sentence 3						
Total:						

Word Selection	I	read	about	a	(object)	.	Total
summary sentence							
Total:							

Daily visual analysis was conducted by comparing data within phases and across adjacent phases and tiers to determine if changes in outcomes occurred as a result of the IV being manipulated. Data were analyzed within and between phases to assess changes in level, trend, variability, immediacy of effect, overlap, and similarity of data patterns across phases per WWC recommendations (WWC, 2010).

At the conclusion of the study, data also were analyzed to evaluate the effect of the intervention package on each type of sentence taught (i.e., 'I see a ____,' and 'I read about a ____.'). The number of correct responses per sentence type was divided by the total number of

possible responses and multiplied by 100 to calculate a percentage correct per sentence type for each participant (see Figure 11 and Figure 12).

The percentage of nonoverlapping data (PND) was one of two ways used to calculate effect size. For calculating PNDs for each participant, a PND calculator was used (Tarlow & Penland, 2016). PND scores range from 0%-100%. Scores 90% and above indicated that the intervention was very effective, 70%-89% indicated that the intervention was effective, 50%-69% indicated a questionable effect, and below 49% indicated an ineffective intervention (Rakap, 2015).

The second method used for calculating effect size was Tau-U (Vannest et al., 2016). Effect size was calculated using an online Tau-U calculator for single case research designs (Vannest et al., 2016). Tau-U scores of >0.8 indicate a large effect, >0.5 indicate a medium effect, and >0.2 indicate a small effect.

Pre-baseline and post-intervention probes were conducted to assess participants' sight recognition of word selection options used in the study for sentence construction (i.e. I, see, a, read, and about) per the recommendation of Pennington et al. (2011). Using a repeated trial data sheet (Figure 6), correct responses were marked with a check. Incorrect responses were marked with a "-". A percentage correct was calculated for each probe. A measure of incidental learning was determined by subtracting the mean baseline probe percent from the mean post-intervention probe percent.

Figure 6

Study Data Sheet: Incidental Learning

Sight Word/Word Selection Recognition Data Collection

Measure of Incidental Learning

Sight Word/Word Selection	Pre-Baseline			Post-Intervention		
	P1	P2	P3	P1	P2	P3
I						
see						
a						
read						
about						
SCORE:						

Social Validity. To establish social validity and, thus, evaluate participants' and other stakeholders' perceptions of the intervention package, the researcher conducted individual information sessions for parents/caregivers of participants. Session one addressed the purpose of the study and how the study would be conducted. During session two, the researcher shared the results of the study. Given that daily reports were a natural part of the classroom routine, parents/caregivers were updated regularly on their child's progress via these reports and in person or in a virtual format when the opportunity presented itself, such as during parent/teacher conferences and afternoon pick-up times. Following the study, parents/caregivers were given a survey. They indicated their answers to the following statements using a five-point Likert scale:

1. How would you rate the intervention? (5- It was very effective. 4- It was effective. 3- It was neither effective nor ineffective. 2- It was somewhat effective. 1- It was not effective.)
2. How would you rate what your child learned during the intervention? (5- I am very pleased with what my child learned. 4- I am pleased with what my child learned. 3- I am neutral regarding what my child learned. 2- I am somewhat pleased with what my child learned. 1- I am not pleased with what my child learned.)
3. How would you rate the intervention in helping your child express him/her/theirself? (5- It was very effective. 4- It was effective. 3- It was neither effective nor ineffective. 2- It was somewhat effective. 1- It was not effective.)

In addition to this, the researcher conducted a minimum of four information sessions with the classroom staff. Session one addressed the purpose of the study and how the study would be conducted. The researcher directed paraprofessionals not to intervene or use a similar intervention during the entirety of the study to avoid possible confounding variables. In sessions two and three, the researcher discussed students' progress and response to the intervention as part of their weekly team meeting. During session four, the researcher shared the results of the study. Following the study, classroom staff was given a survey. They indicated their answers to the following statements using a five-point Likert scale:

1. How would you rate the intervention? (5- It was very effective. 4- It was effective. 3- It was neither effective nor ineffective. 2- It was somewhat effective. 1- It was not effective.)
2. How would you rate what your students learned during the intervention? (5- I am very pleased with what our students learned. 4- I am pleased with what our students learned.

3- I am neutral regarding what our students learned. 2- I am somewhat pleased with what our students learned. 1- I am not pleased with what our students learned.)

3. How would you rate whether or not your students liked the intervention? (5- The students appeared to like the intervention a lot. 4- The students appeared to like the intervention. 3- The students appeared neutral regarding the intervention. 2- The students appeared to like the intervention somewhat. 1- The students did not appear to like the intervention.)
4. How would you rate your team's ability to implement this intervention in your classroom in the future? (5- We could easily implement this intervention in our classroom. 4- We could implement this intervention in our classroom. 3- I am neutral about whether or not we could implement this intervention in our classroom. 2- We could implement this intervention in our classroom; however, it would be difficult. 1- We could not implement this intervention in our classroom.)
5. Once trained, how would you rate your confidence in your ability to implement this intervention? (5- I could easily implement this intervention. 4- I could implement this intervention. 3- I am neutral about my ability to implement this intervention. 2- It would be difficult for me to implement this intervention. 1- I could not implement this intervention.)

Finally, the researcher conducted surveys of participants following the first intervention session and following completion of the final intervention session. Participants marked their responses to three survey questions containing picture responses using a digital format (see Figure 7).

1. What did you think of writing today? (Response choices: smiley face- I liked it., straight face- It was okay., sad face- I did not like it.)

2. Was writing easy, okay, hard? (Response choices: smiley face- easy , straight face- okay, sad face- hard)
3. Do you want to do writing again another time? (Response choices: thumb up- yes or thumb down- no)

Figure 7

Student Participant Social Validity Survey

A blind rater observed one baseline session and one intervention session. The blind rater completed the following questionnaire:

1. Did you notice a change between baseline and intervention?
2. What change did you see?
3. If you saw a change, what are your thoughts about the change you saw?

Interobserver Agreement. In order to demonstrate outcome reliability (WWC, 2016) and determine Interobserver Agreement (IOA), the interventionist collected data during each session and analyzed and graphed results following the session. All sessions were videotaped, and the secondary observer, who was approved through the Institutional Review Board (IRB) and was university staff, randomly chose, viewed, and scored 35% of sessions across all phases for all participants, which exceeded the 20% recommendation of WWC in their publication *Reviewer Guidance for Use With the Procedures and Standards Handbook (version 3.0).* Results were scored on an item-by-item basis. IOA acceptability was set at a minimum 90% agreement or higher. An overall IOA of 100% was obtained from a total of 35% of all study sessions and phases across all participants (see Table 5).

Procedural Fidelity. Procedural fidelity (PF), which was set at 90% or higher, was taken to determine whether the research study, especially the intervention package, was carried out as intended. Following the recommendations of Ledford and Worley (2013), the researcher and second observer identified and reported on targeted behaviors using direct counts. The team measured fidelity across participants and conditions, paying particular attention to control and the IV. The second observer, who was thoroughly trained in the intervention package, collected DV procedural fidelity data on 35% of all sessions in each condition, and a PF of 100% was obtained. The number of agreements was divided by the total number of agreements and disagreements and multiplied by 100 to calculate percentage of procedural reliability.

Interventionist. The researcher served as interventionist. She was trained in CTD, the use of sentence frames, TAI, SBL, data collection, and visual analysis. She previously served as an interventionists in several research studies in which CTD was used; she taught SBL to the students in her class; and she had observed, collected, and analyzed data on students with disabilities for over 30 years. The primary researcher made sure all data collectors for IOA and PF were trained in baseline and intervention procedures as well as data collection procedures.

A classroom paraprofessional acted as the interventionist in the third generalization probe for two participants, Princess and Thanos. She was previously trained in teaching SBL and had taught them for two years. The researcher trained her in generalization procedures using the baseline task analysis and provided a checklist and script for use during the generalization session.

Procedures

Story-Based Lessons

Story-based lessons, an evidence-based practice, have been used to teach literacy to students with IDD (Browder et al., 2009b; Courtade et al., 2013; & Spooner et al., 2009). Each SBL contained a 12-step task analysis used during a read aloud to teach grade-appropriate literacy skills including, but not limited to, engagement with text, choral reading/recitation, identification of vocabulary both in isolation and in text, and responding to comprehension questions related to the text. Each study session consisted of a new SBL. Each SBL was used only one time per participant. All storybooks used for SBL, including books used during baseline probes, generalization, and maintenance, were assessed for difficulty using the books' Lexile levels. Lexile levels for all books fell within the 410–550 range. Storybooks used were of similar length, with all books being between 26 and 31 pages long. Vocabulary for the SBL consisted of

the objects of the model sentences 'I see a (object).' and 'I read about a (object).' All vocabulary was presented in word form. The interventionist taught all vocabulary words using CTD, first using two rounds of zero-second time delay followed by two rounds of five-second time delay prior to reading the story. As part of the natural SBL task analysis, participants were instructed to find the vocabulary, which was highlighted, in the text. Each vocabulary word was identified in text one time per reading.

Below are the steps in a SBL task analysis (see Table 4) that were embedded in each read aloud. The steps depicted were followed during each study session with the exception of step 12. The interventionist had the table below available to consult, and the storybook was tabbed with each step of the SBL task analysis to assist with PF.

Table 4

Story-Based Lesson Task Analysis (Browder et al., 2006a; Browder et al., 2007b)

What the interventionist will do	What the participant will do
1. Get students attention	1. Interact with materials
2. Review vocabulary and new symbols	2. Say/repeat/point to word or symbol
3. Ask for prediction	3. Indicate response to prediction
4. Read the title	4. Point to title
5. Read the author	5. Point to author
6. Ask, "How do we get our story started?"	6. Open book to first page of the book
7. Read text	7. Turn pages when appropriate
8. Pause for repeated story line	8. Anticipate repeated story line or finishes repeated story line
9. Pause for finding the word/picture on	

page	9. Point to picture/ word/ object that teacher says
10. Give student an opportunity to point to chosen line	10. Text point to chosen line in book
11. Ask comprehension question/ review prediction	11. Answer question
12. Present student with opportunity to identify three representations of the target vocabulary	12. Identify three representations of the target vocabulary

Pre-Baseline

Prior to baseline, the interventionist probed participants on recognition of the words found in the study's model sentences (I, see, a, read, and about). Participants were presented with a visual field of four of the words found in the model sentences and directed, "Touch (see)." A correct response was coded with a check. An incorrect response was coded as "-". A percentage score was calculated by dividing the total number correct by the total number of possible correct responses (five). This percentage was used for comparison with post-intervention data as a measure of incidental learning, or unplanned learning that resulted from repetition, observation, and problem solving (Kerka, 2000) when constructing sentences using the Clicker Writer app.

Baseline

Prior to the start of the study, the researcher determined she would use baseline data to assign participants to study tiers. The participant whose baseline data were lowest and most stable would be assigned to tier one, with this criteria being used for all tier assignments. However, given that all participants' received a score of 0% for all baseline data sessions, the

researcher chose to introduce the participant who, based on input from her academic instructors and the results of curriculum-based measures, was expected to demonstrate a change in level and trend. Given that two participants had COVID-related absences, it was determined that Princess would be the first participant to enter into intervention in Tier 1.

During baseline, the interventionist read a grade-appropriate story using the story-based lesson format. She stopped at three predetermined points during the lesson, had participants identify a prechosen vocabulary word in text, directed participants' attention towards an illustration related to what was just read, gave the participants an iPad containing Clicker Writer, and stated, "Write about what you see." At the conclusion of the SBL, the interventionist followed the established generalization procedures, gave the participants an iPad containing Clicker Writer and stated, "Write about what you read." Prompts, reinforcement for correct answers, or error correction procedures were not used, although participants were reinforced for attending behaviors and participation (see Figure 8 for Baseline, Generalization, and Maintenance Task Analysis). Following the lesson, the participants were rewarded with five or more minutes of Earned Free Time.

Figure 8

Baseline, Generalization, and Maintenance Task Analysis

Correct Word Selection to Construct Sentence (SBL)- Baseline, Generalization, and Maintenance

Date: _____ Session Number: _____ Observer: _____ Interventionist: _____

Length of lesson: _____ Title of Book: _____

Lesson Components	Code	Teacher Response	Comments
Vocabulary		1. 0-second time delay prior to SBL- teach 1st vocabulary word	
		2. 5-second time delay prior to SBL- teach 1st vocabulary word	
		3. 0-second time delay prior to SBL- teach 2nd vocabulary word	
		4. 5-second time delay prior to SBL- teach 2nd vocabulary word	
		5. 0-second time delay prior to SBL- teach 3rd vocabulary word	
		6. 5-second time delay prior to SBL- teach 3rd vocabulary word	
		7. 0-second time delay prior to SBL- teach 4th vocabulary word	
		8. 5-second time delay prior to SBL- teach 4th vocabulary word	
Find Vocab in Text		1. 1st vocabulary word- find in text	
		2. 2nd vocabulary word- find in text	
		3. 3rd vocabulary word- find in text	
		4. 4th vocabulary word- find in text	
0-Sec Time Delay		1. Reads text selection related to illustration	
Sentence 1		1a. Stops at predetermined point in book	
		1b. Has participant find vocabulary word in text	
		1c. Directs participant's attention towards illustration	
		1d. Gives participant iPad	

		1e. States, “Write about what you see.”	
		1f. Wait time for participant to respond	
0-Sec Time Delay		2. Reads text selection related to illustration	
Sentence 2		2a. Stops at predetermined point in book	
		2b. Has participant find vocabulary word in text	
		2c. Directs participant’s attention towards illustration	
		2d. Gives participant iPad	
		2e. States, “Write about what you see.”	
		2f. Wait time for participant to respond	
0-Sec Time Delay		3. Reads text selection related to illustration	
Sentence 3		3a. Stops at predetermined point in book	
		3b. Has participant find vocabulary word in text	
		3c. Directs participant’s attention towards illustration	
		3d. Gives participant iPad	
		3e. States, “Write about what you see.”	
		3f. Wait time for participant to respond	
0-Sec Time Delay		4. Reads text selection related to illustration	
Sentence 4		4a. Stops at predetermined point in book	
		4b. Has participant find vocabulary word in text	
		4c. Directs participant’s attention towards illustration	
		4d. Gives participant iPad	
		4e. States, “Write about what you see.”	
		4f. Wait time for participant to respond	
Earned Free Time		5. Reinforce	

Intervention

During the intervention phase, the interventionist read a grade-appropriate story using a SBL format (see Figure 8). She stopped at three predetermined points during the lesson, had participants identify a prechosen vocabulary word in text, directed participants’ attention towards

and discussed an illustration related to what was just read, gave the participants an iPad containing Clicker Writer, and stated, “Write about what you see.” Points at which the interventionist stopped were determined by both story content and illustrations. Illustrations contained clear depictions of a character or object that was discussed in the section of text read. The interventionist used a model with the entire sentence uncovered (I see a ____.) and started with an initial zero-second time delay in which the correct word selection for sentence construction was immediately modeled. Zero-second time delay looked like the interventionist pointing to the correct word on the model, and then immediately pointing to the correct word selection on the iPad, leaving her finger there until the student responded correctly. If the student attempted to respond incorrectly, the interventionist guided him/her/them to the correct answer. The zero-second time delay round occurred for three days prior to the introduction of the five-second time delay round. Data collected during the zero-second time delay round were not reported or graphed.

After the zero-second delay round, the interventionist moved to a five-second delay round to instruct the participants on sentence construction using correct word selection. During the five-second delay round, the interventionist stated, “Write about what you see” and immediately presented the iPad with the Clicker Writer app. The interventionist waited five seconds for the participant to initiate a response. If the participant responded correctly, the participant was reinforced using a reinforcer identified for each participant, and the response was coded on the data sheet, giving one point for each correct word selection and the inclusion of a period at the end of the sentence. If an incorrect response was given, the response was deleted and coded with “-“. The interventionist then repeated, “Write about what you see.” During error correction, the interventionist showed the participant the correct word selection at the point of

error. The interventionist presented the model sentence with only the flap for that correct word selection visible. All other words in the sentence remained covered with flaps to obscure the participants' view. The interventionist returned to zero-second time delay, pointed to the correct word selection on the model and then on the iPad, and allowed wait time for the participant to respond. Following error correction, the interventionist removed the model sentence and allowed the participant the opportunity to complete the sentence, stating, "Write about what you see." Each incorrect response given by the participant in word selection was corrected using error correction procedures. One point was given for each correct word selection in the sequence and for the inclusion of a period at the end of the sentence for a total of 15 points. If no attempt to respond was made, the interventionist prompted the student using their controlling prompt, and coded a "-" for that word selection. The interventionist followed error correction procedures as needed.

At the conclusion of the SBL, the interventionist gave the participants an iPad containing Clicker Writer and stated, "Write about what you read." This summary sentence served as the second DV. The interventionist followed the same procedures for the second DV as she did for the first DV using the model sentence "I read about a ____," as the summary sentence. Following the lesson, the participant was rewarded with five or more minutes of Earned Free Time, a natural consequence in the participants' classroom (see Figure 9 for Intervention Task Analysis).

Figure 9

Intervention Task Analysis

Correct Word Selection to Construct Sentence (SBL)- Intervention

Student: _____ Date: _____ Session Number: _____

Title of Book: _____

Lesson Components	Code	Teacher Response	Comments
Vocabulary		1. 0-second time delay prior to SBL- teach 1st vocabulary word	
		2. 5-second time delay prior to SBL- teach 1st vocabulary word	
		3. 0-second time delay prior to SBL- teach 2nd vocabulary word	
		4. 5-second time delay prior to SBL- teach 2nd vocabulary word	
		5. 0-second time delay prior to SBL- teach 3rd vocabulary word	
		6. 5-second time delay prior to SBL- teach 3rd vocabulary word	
		7. 0-second time delay prior to SBL- teach 4th vocabulary word	
		8. 5-second time delay prior to SBL- teach 4th vocabulary word	
Find Vocab in Text		1. 1st vocabulary word- find in text	
		2. 2nd vocabulary word- find in text	
		3. 3rd vocabulary word- find in text	
		4. 4th vocabulary word- find in text	
5-Sec Time Delay		1. Reads text selection related to illustration	
Sentence 1		1a. Stops at predetermined point in book	
		1b. Has participant find vocabulary word in text	
		1c. Directs participant's attention towards illustration	
		1d. Gives participant iPad	
		1e. States, "Write about what you see."	

		1f. 5-second time delay	
		1g. If no response, give controlling prompt	
		1h. Remove model sentence to allow participant to continue	
		1i. If incorrect, delete, repeat, “Write about what you see.”	
		1j. Present model sentence with only missed selection showing	
		1k. Give controlling prompt	
		1l. Wait time for participant to respond	
5-Sec Time Delay		2. Reads text selection related to illustration	
Sentence 2		1a. Stops at predetermined point in book	
		2b. Has participant find vocabulary word in text	
		2c. Directs participant’s attention towards illustration	
		2d. Gives participant iPad	
		2e. States, “Write about what you see.”	
		2f. 5-second time delay	
		2g. If no response, give controlling prompt	
		2h. Remove model sentence to allow participant to continue	
		2i. If incorrect, delete, repeat, “Write about what you see.”	
		2j. Present model sentence with only missed selection showing	
		2k. Given controlling prompt	
		2l. Wait time for participant to respond	
5-Sec Time Delay		3. Reads text selection related to illustration	
Sentence 3		3a. Stops at predetermined point in book	
		3b. Has participant find vocabulary word in text	
		3c. Directs participant’s attention towards illustration	
		3d. Gives participant iPad	
		3e. States, “Write about what you see.”	
		3f. 5-second time delay	
		3g. If no response, give controlling prompt	

		3h. Remove model sentence to allow participant to continue	
		3i. If incorrect, delete, repeat, “Write about what you see.”	
		3j. Present model sentence with only missed selection showing	
		3k. Given controlling prompt	
		3l. Wait time for participant to respond	
5-Sec Time Delay		4. Reads text selection related to illustration	
Sentence 4		4a. Stops at predetermined point in book	
		4b. Has participant find vocabulary word in text	
		4c. Directs participant’s attention towards illustration	
		4d. Gives participant iPad	
		4e. States, “Write about what you see.”	
		4f. 5-second time delay	
		4g. If no response, give controlling prompt	
		4h. Remove model sentence to allow participant to continue	
		4i. If incorrect, delete, repeat, “Write about what you see.”	
		4j. Present model sentence with only missed selection showing	
		4k. Given controlling prompt	
		4l. Wait time for participant to respond	
Earned Free Time		5. Reinforce	

Generalization

Three probes were taken to assess generalization for two participants, Princess and Thanos, while two generalization probes were taken for Unicorn and Sonic as a result of time constraints. Due to COVID cases and quarantines, generalization measures were not taken at consistent intervals across participants. Instead, probe intervals were determined by participant attendance and wellbeing, which was defined as participants possessing the ability to attend until

the completion of the lesson and verbally stating a willingness to participate. During the generalization phase, new SBL were used to assess whether participants had generalized construction of sentences with correct word selection during a SBL and a summary sentence using correct word selection following a SBL. The interventionist used baseline procedures during the generalization phase, and sentences were scored using the intervention phase scoring procedures. During the first generalization round, data were collected on construction of sentences during a SBL using an informational text as opposed to a storybook, evaluating for generalization of materials. During the second generalization round, data were collected on generalization of response mode, as students constructed sentences by gluing words that had been cut out and displayed in the same format as those on the iPad on a 11x6 sheet of white cardstock. During the third generalization round, which only two participants received, data were collected on construction of sentence during a SBL that was conducted by a novel instructor, a paraprofessional in the classroom.

Maintenance

Three probes were taken for Princess and Thanos, one each at approximately two, four, and five and a half weeks following participants' end of intervention to assess maintenance. Due to time constraints, Unicorn and Sonic had two maintenance probes, one each at approximately two weeks and three and a half week post-intervention. During the maintenance phase, new SBL were used to assess whether students had maintained construction of sentences with correct word selection during a SBL and a summary sentence using correct word selection following the SBL. The interventionist used baseline procedures during the maintenance phase. Sentences were scored using the intervention phase scoring procedures.

Post-Intervention

Following the last intervention session, the first maintenance session, and the last study session, the interventionist conducted probes of participants on recognition of the words needed to construct targeted sentences (I, see, a, read, and about). Pre-baseline procedures were used. A comparison of pre-baseline and post-intervention data were used as a measure of incidental learning.

Chapter 4. Results

Study results are reported in terms of range and mean for all phases and all participants. During baseline sessions (see Figure 10), participants one, two, three, and four made no correct word selections to construct sentences using TAI during SBL, resulting in a score of 0% for each participant. Given that data were low and stable across all participants, the intervention was started with participant one, Princess. Once data showed a therapeutic effect, e.g. showed an accelerating trend, rapid acceleration, and stability, a new participant was brought into intervention. Following intervention, all four participants were able to generate both types of sentences (dependent variables one and two). Although all participants demonstrated a slight decrease in correct word selection from intervention to generalization, all participants generalized the target skills to novel material and response mode, and two participants generalized sentence construction to a novel instructor. Only Princess showed percentage of correct word selection for sentence construction consistent with her final intervention probe during the maintenance phase (maintenance 1); however, all participants showed maintenance of correct word selection for sentence construction above baseline levels. Probes indicate the generalization and maintenance measures were on target with the level of data in the intervention across participants and across DVs (see Figure 10). Furthermore, all four participants demonstrated mastery in sight word recognition of the word selections used to construct sentences (I, see, a, read, and about) (see Figure 13 for summary of results).

Figure 10

Percent of Correct Word Selection to Construct Sentences: Both Sentence Types (I see a ____, and I read about a ____.)

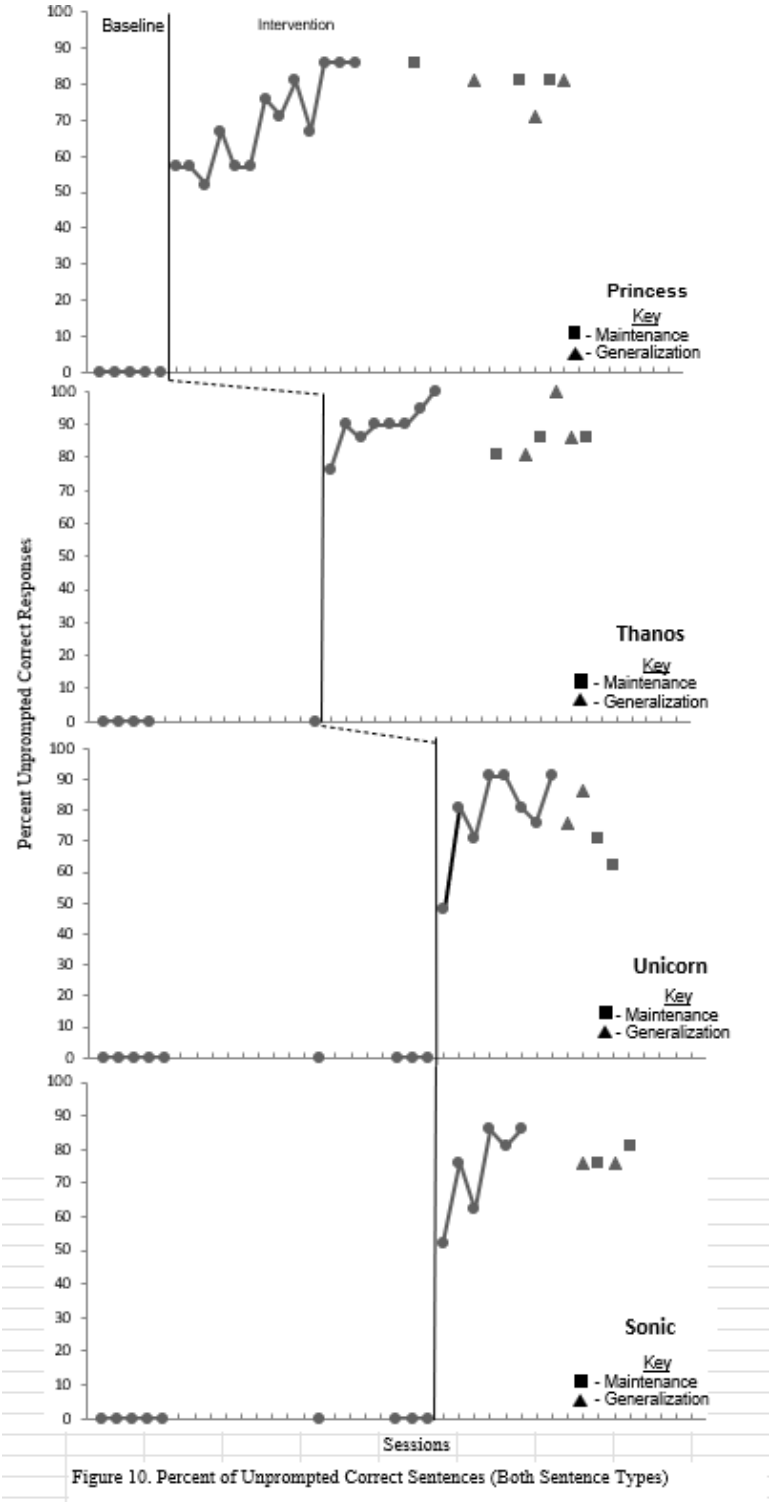


Figure 10. Percent of Unprompted Correct Sentences (Both Sentence Types)

Figure 11

Percent of Correct Word Selection to Construct Sentences: First Sentence Type (I see a ____.)

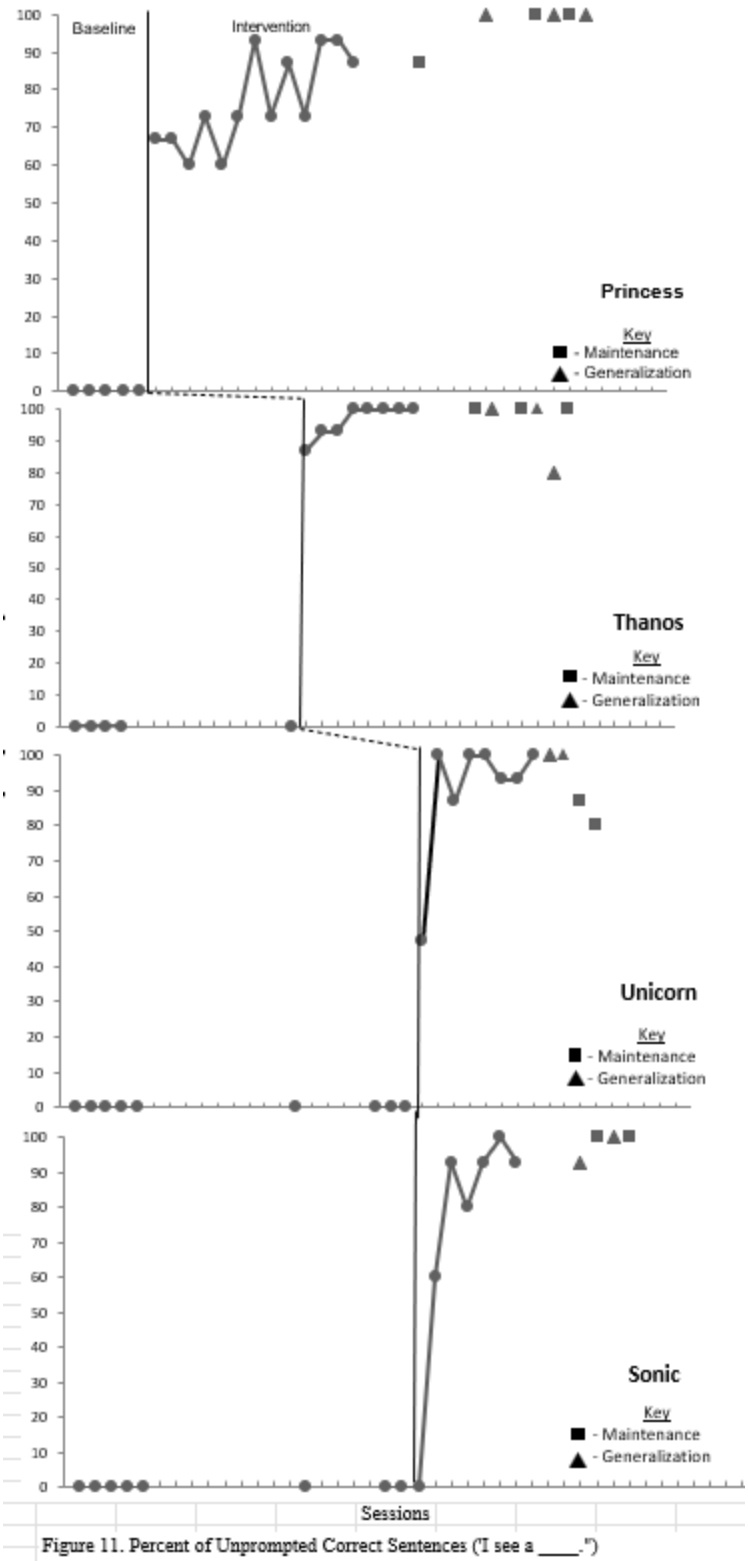


Figure 11. Percent of Unprompted Correct Sentences ("I see a ____.")

Figure 12

Percent of Correct Word Selection to Construct Sentences: Second Sentence Type (I read about a ____.)

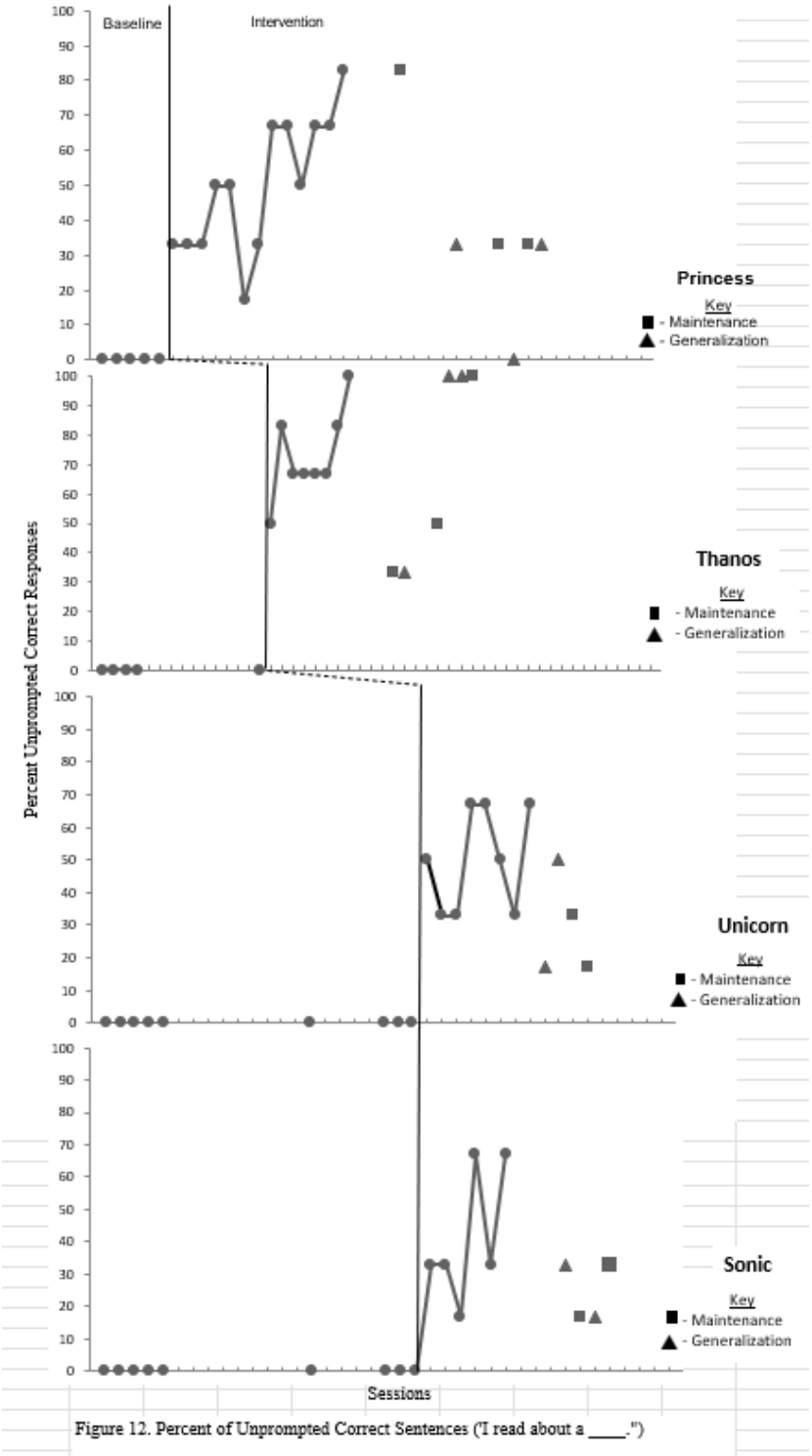


Figure 12. Percent of Unprompted Correct Sentences ("I read about a ____.")

Participant One: Princess

Acquisition

During baseline sessions, Participant One, Princess, had no correct word selection; therefore, baseline mean was 0%. During intervention, which consisted of 13 sessions, Princess showed a rapidly accelerating trend with scores ranging from 52% to 86% and a mean of 69%. Princess' decreased data between sessions 9 (81%) and session 10 (67%) should be noted. This could be due to the fact that a favored classmate had been absent due to COVID quarantine and returned the day of session 10, which may have affected her performance. There was no overlap in data with a Percent Non-overlapping Data (PND) of 100% (see Figure 10).

Given that two different sentence types were taught, 'I see a ____,' and 'I read about a ____,' data were analyzed for outcomes related to each sentence type. Princess' data on the 'I see a ____,' sentence indicate intervention scores from 67% to 93% with a mean of 77%, or a 77% growth over baseline. When analyzing data on the sentence 'I read about a ____,' it was noted that Princess' scores fell between 17% and 83% during intervention, for a mean score of 50%, which was a 50% growth over baseline (see Figure 11 and Figure 12).

Generalization

Three types of generalization probes were taken: generalization of materials, generalization of response mode (technology-aided vs. no technological assistance), and generalization of instructor. Generalization probes were taken during sessions 20, 22, and 24. Princess showed generalization of correct word selection to construct sentences using TAI during a SBL with a score of 81% during the first generalization probe, which focused on generalization of materials by using an informational text as opposed to a storybook. During the second generalization probe, a generalization of response mode that required her to respond by gluing

words that had been cut out and arranged in an identical random format to the technology-based word bank via a screenshot, Princess scored at 71%. She received a score of 81% during the third probe in which instruction was delivered by a novel instructor. Averaging the scores received across generalization probes, Princess showed growth of 78% over baseline during generalization when using her mean score. Princess was able to generalize targeted skills across contexts based on probes given (see Figure 10).

During generalization of the 'I see a ____' sentence type, Princess scored 100% on the generalization of materials, 100% on generalization of response, and 100% on generalization of instructor, for a mean score of 100%. When evaluating Princess's scores on the 'I read about a ____' sentence, it was noted that she scored 33%, 0%, and 33% respectively. As a result, she received a mean score of 22%, or 22% growth over baseline. It should be noted that Princess became dysregulated at the end of the second generalization session, which may have impacted her performance (see Figure 11 and Figure 12).

Maintenance

A maintenance probe was taken two weeks after the participant's final intervention session. Princess showed maintenance of correct word selection to construct sentences during a SBL with a score of 86%, which was equivalent to her final intervention probe. During her second maintenance probe, which took place four weeks post-intervention, she received a score of 81%. Princess had a third maintenance probe at five and a half weeks and received a score of 81%. Using the mean of both maintenance probes, Princess showed growth of 83% over baseline during maintenance (see Figure 10).

During Princess' maintenance probes, she received a score of 87% for 'I see a ____' on the two-week probe following intervention, a score of 100% on the four-week probe, and a score

of 100% at 5.5 weeks post intervention for a mean score of 96%. On the 'I read about a ____' maintenance probes, Princess' scored 83% on probe one and 33% on probes two and three. Data indicate a mean score of 50% based on all maintenance probes for the 'I read about a ____' sentence (see Figure 11 and Figure 12).

Interobserver Agreement (IOA)

Interobserver agreement data for all participants and all phases can be found on Table 5. IOA was conducted by the researcher, who served as the interventionist, and a university staff member who is trained in single case research design, interobserver agreement procedures, and the intervention package being used. IOA was taken on 33% of Princess' total sessions; this included 20% of baseline, 37.5% of intervention, and 33% of maintenance. The interventionist and second observer had a total item-by-item agreement of 99% (range of 93-100) across all phases. There was 100% agreement in baseline, 99% agreement in intervention (range 93-100), and 100% agreement in maintenance and generalization.

Table 5

Interobserver Agreement

Participant	Time Collected	Minimum	Maximum	Mean
Princess	33%	93%	100%	99%
Thanos	37%	100%	100%	100%
Unicorn	28.5%	100%	100%	100%
Sonic	42%	100%	100%	100%
All	35%	98%	100%	100%

Princess was eager to participate in all sessions, as she was an active seeker of adult attention; however, she was easily distracted by the actions of others in the classroom. This may have impacted her performance on the tenth intervention session and the second generalization probe. During intervention session 10, a student, who was Princess' good friend and who was also a participant in the study, returned to school after being out for a week. Princess was distracted by his presence in the instructional area and engaged in repetitive statements related to his return. In addition to this, Princess also experienced dysregulation throughout the school day. Although rare during the duration of this study, she experienced such dysregulation during her second generalization session which may have impacted her performance. As mentioned previously, participation in the study and writing became a preferred activity for Princess and, once she exited intervention, the wait between intervention and maintenance/generalization became a trigger for mild to severe dysregulation daily, as did the conclusion of her portion of the study.

Following an error analysis, it was noted that the most common error Princess made for sentence type one was related to the object of the sentence, or new sight words. Error analysis indicates the most common error for the second sentence type occurred with the 'about' word selection.

The researcher noted that as Princess began to construct sentences, she also began to check her work for correctness, a skill that had not been seen previously by classroom staff and that was not directly taught. This incidental learning began to show itself in the first study session, in which she made the word selections 'I' and 'see' and then read what she had written before continuing. This was observed at each session that followed and with all sentence types. A second unintended benefit of the study was that it provided an opportunity for Princess to read

her first complete sentences, ‘I see a _____’ and ‘I read about a _____.’ In addition to this, Princess engaged in text-pointing as she read the sentences she wrote, which was a demonstration of generalization of a targeted skill taught within the SBL task analysis. Finally, while Princess was able to write her name with major deviation in size and form prior to the study, but was unable to write other letters and/or words, the intervention package allowed her to write and access the general curriculum at higher levels than she had previously experienced.

Participant Two: Thanos

Acquisition

The performance of the second participant, Thanos, on correct word selection to construct sentences using TAI during a SBL is depicted in Figure 10. During baseline sessions, Thanos had a stable score of zero across his initial four baseline data sessions. Due to COVID-related absences from school, only four baseline points were taken. Averaging his total baseline scores, including four initial baseline points and one pre-intervention point, Thanos’ baseline mean was 0% across all five baseline points. It should be noted that Thanos, unlike participants three and four, had one probe point before entering intervention, which meets the WWC SCD Standards With Reservations, as opposed to three probe points needed to meet WWC SCD Standards Without Reservations (WWC, 2021). Given that Thanos scored 100% on identification of all words used to construct sentences in the study prior to baseline and based on the recommendations of Kratockwill et al. (2021) in the peer-reviewed article *Single-Case Design Standards: An Update and Proposed Upgrades*, the researcher felt one probe point was sufficient to indicate his present level on construction of sentences. This decision was further supported by Harris et al. (2019), who noted that there were some situations in which revision of the criteria for a minimum number of data points in multiple-baseline designs is appropriate, as five data

points per phase may inhibit a researcher's ability to conduct high-quality research resulting in evidence-based practices. During intervention, which lasted for 8 sessions, Thanos showed an accelerating trend, rapid acceleration, stability, and a high level of correct word selection with scores ranging from 76% to 100% and a mean of 90%. There was no overlap in data with a PND of 100% (see Figure 10).

Data on the two sentence types taught were analyzed for outcomes related to each sentence type. Thanos' scores on the 'I see a ____,' sentence ranged from 87% to 100% with a mean of 97%, for a 97% growth over baseline, while his scores on the 'I read about a ____,' sentence ranged from 50% to 100% with a mean of 73%, resulting in a 73% increase over baseline scores (see Figure 11 and Figure 12).

Generalization

As with Princess, three generalization probes were taken (generalization of materials, response mode, and instructor), one each during sessions 15, 17, and 18. During generalization probes, Thanos' received scores of 81% (materials), 100% (response mode), and 86% (instructor). Using the average of these three scores, Thanos' mean generalization score was 89%. Given a baseline score of 0%, Thanos generalized sentence construction of the sentence types taught at 89% above baseline, which further establishes the intervention package as effective in teaching sentence construction across contexts (see Figure 10).

During generalization of the 'I see a ____' sentence type, Thanos received a score of 100% on generalization of materials, 100% on generalization of response, and 80% on generalization of instructor, for a mean score of 90%. Thanos' scores on the 'I read about a ____' sentence were noted to be 33%, 100%, and 100% respectively with a mean score of 78%, or 78% growth over baseline. It should be noted that Thanos had returned to school after an

extended absence during his initial generalization session, which may have impacted his performance (see Figure 11 and Figure 12).

Maintenance

Three maintenance probes were taken, one at two weeks post-intervention, a second at four weeks post-intervention, and a third at five and a half weeks post-intervention. During his first maintenance probe, Thanos showed maintenance of correct word selection to construct sentences during a SBL with a score of 81%. During his second maintenance probe, Thanos received a score of 86%, which was equivalent to his third intervention session. During his third maintenance session, Thanos received a score of 86%. Given data from all maintenance probes in which Thanos had a mean score of 84%, he showed growth of 84% over baseline during maintenance (see Figure 10).

When analyzing maintenance data, the researcher noted that Thanos received scores of 100%, 100%, and 100% on correct word selection for sentences constructed for the 'I see a ___' sentence. His mean maintenance score for the 'I see a ____' sentence was 100%, or 100% above baseline scores. Scores on 'I read about a ____' ranged from 33% to 100% with Thanos scoring 61% above baseline. The decrease of maintenance one and maintenance two scores may be related to Thanos' return to school following extended absences (see Figure 11 and Figure 12).

Interobserver Agreement (IOA)

Interobserver agreement measures for Thanos were conducted during 37% of his total sessions (40% of baseline, 37.5% of intervention, and 33% of maintenance and generalization). An agreement of 100% was calculated between the researcher and the second observer (see Table 5).

Thanos, who had COVID-related absences between intervention's end and initial generalization and maintenance sessions, readily participated in all study sessions, often asking at the beginning of the day if it was his day for 'story-based lesson and writing,' as intervention sessions were called. Both classroom staff and his occupational therapist stated that this was a marked change from his typical response to writing instruction using a program entitled *Handwriting Without Tears* (Olsen, 1977), which often resulted in dysregulation including refusals to participate, crying, and yelling, and his written expression program, *Write Your Story* (Nelson et al., 2018), which is picture supported and, thus, resulted in lesser degrees of resistance As with Princess, it was noted that Thanos began to check his work by reading the sentences he had written, a skill that was not directly taught during the study and that demonstrated generalization of skills taught during a SBL. There were also three instances in which Thanos made an incorrect word selection and immediately self-corrected prior to the interventionist moving to error correction, again, a skill that was not targeted. Credit was given when this occurred. Finally, it was noted that Thanos' responses became more fluent as he progressed through intervention. While the interventionist did not assess fluency, it was noted that in early intervention sessions Thanos scanned and/or searched for the correct word choice, whereas in his final two intervention sessions and during generalization and maintenance, he was able to immediately find and choose the correct word selection with fluent scanning. Error analysis reveals that Thanos' most common error occurred at the word selection 'read'.

Participant Three: Unicorn

Acquisition

The performance of the third participant, Unicorn, is depicted in Figure 10. During baseline sessions, Unicorn received a flatline score of 0% across five baseline points, one probe,

and three pre-intervention baseline sessions, giving her a mean baseline score of 0%. During intervention, which consisted of 8 sessions, Unicorn's data showed a rapidly accelerating trend with scores ranging from 48% to 91% and a mean of 79%. There was no overlap in data for a PND of 100% (see Figure 10).

Unicorn scored between 47% and 100% during intervention sessions on the 'I see a ____' sentence, receiving a mean score of 90%, or a 90% increase over baseline. She demonstrated a 50% increase over baseline for the 'I read about a ____' sentence with scores ranging from 33% to 67%. Analysis of scores indicate a 90% growth for 'I see a ____' and a 50% growth for 'I read about a ____," (see Figure 11 and Figure 12).

Generalization

Probes were taken on generalization of materials and response mode during sessions 18 and 19. Due to time constraints, a third generalization probe was not conducted. Unicorn showed generalization of correct word selection to construct sentences using TAI during a SBL with a score of 76% during the first probe and 86% during the second probe. Using the average of both generalization probes, Unicorn demonstrated growth of 81% over baseline during generalization when using her mean score (see Figure 10).

When analyzing Unicorn's generalization scores, it was noted that she had a 100% growth over baseline for the 'I see a ____' sentence, with scores of 100% on both generalization of material and response mode for a mean score of 100%. Growth for 'I read about a ____' was 34% over baseline, with Unicorn scoring 17% on the first generalization probe and 50% on the second generalization probe (see Figure 11 and Figure 12).

Maintenance

One maintenance probe, during which Unicorn scored 71%, was taken two weeks post-intervention. A second maintenance probe, which was given approximately three and a half weeks post-intervention, resulted in a score of 62%. Given both probes, Unicorn showed maintenance of correct word selection to construct sentences using TAI during a SBL with a score of 67%. Unicorn showed growth of 67% over baseline during maintenance scores (see Figure 10).

The researcher analyzed Unicorn's maintenance data to determine her growth with the 'I see a ____' and 'I read about a ____' sentence types. Having scores of 87% and 80% on 'I see a ____,' Unicorn's mean was 84% which represented an 84% increase over baseline scores. On the sentence 'I read about a ____,' Unicorn achieved a mean score of 25%, or 25% growth, with maintenance scores of 17% and 33% (see Figure 11 and Figure 12).

Interobserver Agreement (IOA)

Given analysis of IOA measures conducted by the researcher and university staff, IOA was conducted on 28.5% of Unicorn's total sessions with an agreement of 100% across all sessions and phases. IOA for all phases was as follows: 100% agreement for baseline (22% of all baseline sessions), 100% agreement for intervention (37.5% of intervention sessions), and 100% agreement for maintenance and generalization (25% of total sessions).

Unicorn was an eager participant, as demonstrated by her cheers of 'Yay!' when informed it was her day for 'story-based lesson and writing'. Per classroom staff, she responded to the intervention package more quickly than anticipated, with a strength in visual memory was noted. As with Thanos, her fluency of response increased over the duration of the study as a result of her moving from a pattern of randomly searching to a process of systematically

scanning word selection choices. This skill was neither directly taught nor a DV in the study. A final benefit of the study was a demonstration of self-advocacy and self-determination observed in Unicorn when she made an error or perceived she made an error. Once the interventionist gave any indication of error correction, even the slightest body movement, Unicorn began to hold her hand out signaling 'stop' or held the interventionist's hand down to prevent her from moving to error correction. At these times, the interventionist continued with error correction per the implementation plan, although there was one incident in which Unicorn made an error and immediately self-corrected. Credit was given in this instance. Error analysis indicates Unicorn's most common error occurred at the word selection 'about'.

Participant Four: Sonic

Acquisition

The performance of the fourth study participant, Sonic, on correct word selection to construct sentences using TAI during a SBL is depicted in Figure 10. During baseline sessions, Sonic had a stable score of zero correct word selection for a score of 0% on all nine baseline sessions including initial baseline and pre-intervention baseline probes; therefore, baseline mean was 0%. During intervention, which lasted 6 sessions due to multiple COVID-related absences and time constraints, Sonic showed an accelerating trend and rapid acceleration on correct word selection to construct sentences using TAI. Sonic's scores during intervention ranged from 52% to 86% with a mean score of 74%. Data indicate there was no overlapping data with a PND of 100% (see Figure 10).

Given that the study involved two sentence types, 'I see a ____' and 'I read about a ____', the researcher assessed Sonic's data for range, mean, and percent of growth. On the 'I see a ____' sentence type, Sonic's scores ranged from 60% to 100% with a mean of 87% and 87%

growth. When analyzing results on 'I read about a ____,' data indicate a range of 17% to 67%, a mean of 42%, and percent of growth of 42% (see Figure 11 and Figure 12).

Generalization

Generalization probes were taken on generalization of materials and response modes on sessions 16 and 18, respectively. Sonic demonstrated generalization of correct word selection to construct sentences using TAI during a SBL with a score of 76% on generalization of materials and 76% on generalization of response mode. Sonic demonstrated growth of 76% over baseline during generalization when using his mean score for all generalization probes (see Figure 10).

When assessed for generalization of the intervention package, the researcher used the data collected to assess Sonic on generalization of the 'I see a ____' sentence type for materials (93%) and response mode (100%). Given these scores, the researcher determined that Sonic achieved a mean score of 97%, indicating a 97% increase over his baseline score of 0% on the 'I see a ____' sentence. Scores also indicated growth of 25% on the 'I read about a ____' sentence type with scores of 33% on generalization of materials and 17% on generalization of response mode. When averaged, Sonic had a mean score of 25% (see Figure 11 and Figure 12).

Maintenance

Maintenance probes were taken at two and approximately three and a half weeks following intervention. During the first probe, Sonic showed maintenance of correct word selection to construct sentences using TAI during a SBL with a score of 76%. During his second maintenance probe, Sonic scored 81%. Given both maintenance probes, Sonic demonstrated growth of 79% over baseline during maintenance sessions (see Figure 10).

Analyzing the data based on sentence-type, Sonic received a score of 100% on his first maintenance probe when assessing 'I see a ____' and a score of 100% on his second probe.

When his mean score of 100% was compared with his baseline mean of 0%, Sonic experienced 100% growth on 'I see a ____." Focusing on the second sentence, 'I read about a ____,' the researcher noted that data indicate maintenance scores of 17% and 33%, a mean of 25%, and growth on the 'I read about a ____'at 25% over baseline (see Figure 11 and Figure 12).

Interobserver Agreement (IOA)

Interobserver agreement measures were taken during 42% of Sonic's sessions including 33% of baseline, 57% of intervention, and 50% of maintenance and generalization. Data indicated an agreement of 100% across all phases (see Table 5).

Sonic intermittently showed enthusiasm towards participating in study sessions. His enthusiasm was most often tied to a peer wanting to participate at his scheduled time and him being able to 'go first' or the topic of the storybook. Sonic had COVID-related absences from the study between his last zero-second time delay round and session 10, his first intervention session, and session 15, his last intervention sessions, and session 16, his first generalization probe. Each time he returned to school, the study sessions continued where they left off. Although there were sessions that began in mild resistance or displeasure, as demonstrated by Sonic's statements related to wanting to have Earned Free Time/recess or not liking the topic of the book, in each instance, once instruction began Sonic became actively engaged, as observed via his participation in the repeated storyline, answering comprehension questions, and engagement in the desired writing behaviors. There were also four occasions when Sonic requested to use the iPad (for writing) without prompting prior to the predetermined section of the story. In addition to this, when Clicker Writer read his sentence aloud and Sonic realized it was correct, he regularly stood up, cheered for himself, and requested high fives.

Error analysis of sentences constructed indicates that Sonic's most common error occurred at the word selection 'read'. The interventionist observed that each time this occurred, Sonic voiced that he was looking for the word 'see'. For example, he would choose the first word 'I' and then voice 'see' while scanning.

Sight Word/Word Selection Recognition

The ability to read sight words is a critical skill for all readers to become fluent (Fraher et al., 2019). Sight word instruction has been an integral part of reading instruction for students with IDD throughout the years. For example, in a meta-analysis done on sight word research and its implications on teaching functional reading to students with moderate and severe disabilities, Browder and Xin (1998) noted that sight word instruction had been used to teach daily living skills (Baumgart & VanWalleghem, 1987, Browder et al., 1984), functional academics (Browder & D'Huyvetters, 1988, Cuvo & Klatt, 1992), and general education vocabulary words (Browder et al., 2012, Johnson et al. 1996). Recognition of sight words/word selections used to construct study sentences was assessed pre-baseline and post-intervention as a measure of incidental learning. Results can be found in Figure 13. Given three pre-intervention and three post-intervention probes for all participants, Princess showed an increase in sight word recognition from mean of 33% pre-baseline (scores of 40%, 20%, and 40% respectively) to a mean of 100% post-intervention, a result of incidental learning, for a growth of 67%. Pre-baseline, Thanos was able to identify the sight words used for word selection to construct sentences with 100% accuracy across all three probes. He maintained this level during his post-intervention probes. Unicorn showed an increase of 73%, from a 33% mean pre-baseline (scores of 20%, 40%, and 20% respectively) to a mean of 100% post-intervention. Finally, Sonic, who had a pre-baseline mean of 40% (scores of 40% on all pre-assessment) and 100% post-intervention (scores of 100%

on all probes), showed growth of 60% when identifying sight words needed to construct study sentences. While not a DV, three participants demonstrated growth ranging from 60% to 73% on sight word/word selection recognition as a result of incidental learning. The fourth participant, Thanos, maintained word recognition at 100% (see Figure 13).

Figure 13

Percent of Correct Identification of Word Selections Used to Construct Sentences

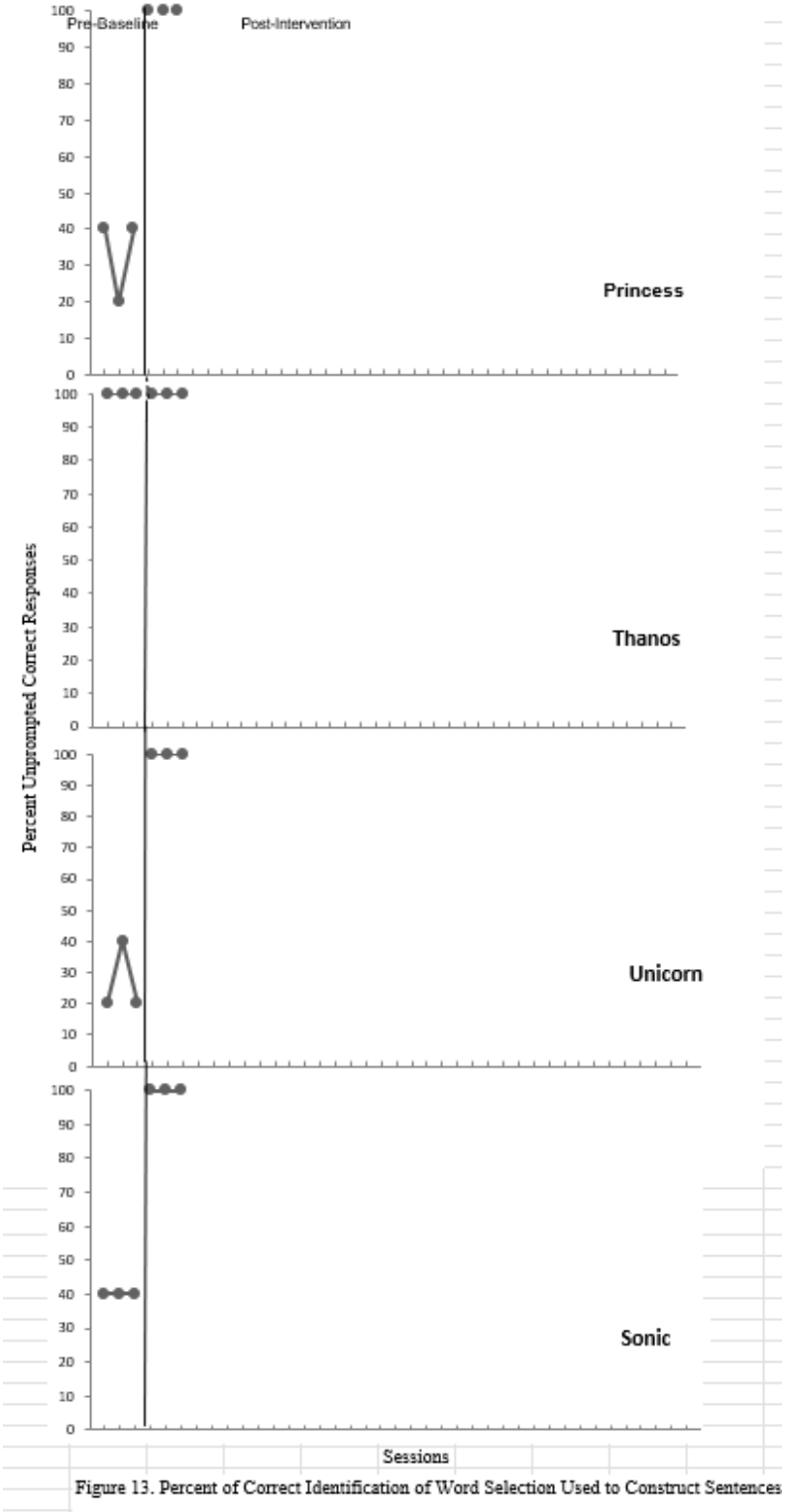


Figure 13. Percent of Correct Identification of Word Selection Used to Construct Sentences

Effect Size

Effect size was also calculated using an online Tau-U calculator for single case research designs (Vannest et al., 2016). Calculation results for this study indicate a 1.0 effect size, which represents a large effect according to Cohen's *d* (Brydges & Sands, 2019), a p-value of 0.0, which is an indication of statistical significance when using a 0.05 threshold (Di Leo & Sardanelli, 2020), and a confidence level of 95% for correct word selection to construct sentences using TAI (see Table 6).

Table 6

Effect Size

Dependent Variable	Effect Size	Number of Participants	P-Value	CI 95%
Percent of Correct Word Selection to Construct Sentence	1.0	4	0.0	0.6595<>1

Interobserver Agreement

Interobserver Agreement measures was taken for 35% of the total study sessions: 29% of all baseline session (100% agreement), 42% of intervention sessions (100% agreement), and 35% of generalization and maintenance sessions (100% agreement). IOA scores ranged from 93% to 100% with a mean of 100% across all participants and phases.

Procedural Fidelity

Measures of PF were taken for all participants across 35% of the total study sessions with a mean of 100% reported by the second observer.

Social Validity

Social validity measures were gathered at the conclusion of the study from parents/caregivers, classroom staff, participants and blind rater. The results are as follows:

Parents/Caregivers

Following completion of all phases of the study, the researcher surveyed parents/caregivers. Results of the survey indicate that all parents/caregivers rated the intervention as very effective overall. Each stated that they were very pleased with what their child learned during the intervention, and that the intervention was very effective in helping their child express him/her/themself. Statements made by parents/caregivers in the comments section of the survey included, “We are very thankful for this program and for the unique opportunity it gives my son to learn at his own pace,” “It’s not only beneficial for learning but also makes learning more fun for the children,” “I knew she could do it,” and “I knew she was smart!” Based on the results of the parent/caregiver survey, there was an indication of strong social validity for the intervention package in teaching sentence construction using TAI.

Classroom Staff

Following the last information session, the researcher reviewed social validity surveys completed by classroom staff. Paraprofessionals’ responses indicate that the classroom staff found the intervention to be effective according to one paraprofessional and very effective based on scores given by three paraprofessionals. They indicated they were pleased (1) and very pleased (3) with what students learned and stated that the students appeared to like the intervention (1 paraprofessional) and like the intervention a lot (3 paraprofessionals). Three classroom staff members also stated they believed their team could easily implement the intervention package in their classroom in the future, while one team member was neutral about

her ability for implementation. One staff member noted, however, that the intervention would need to be taught to a group of students rather than one-on-one for it to be feasibly implemented in the classroom due to the time constraints of the school day and need for instruction in other academic areas. Given the responses of the four classroom paraprofessionals, there was strong social validity for the use of the intervention package to teach construction of sentences using TAI in the classroom setting.

Participants

Following their first intervention session, participants were surveyed to determine what they thought of writing that day, if they thought writing was easy, okay, or hard, and if they would like to do writing again another time. Results of the first survey indicate that all four participants enjoyed writing following day one of intervention. Three participants, or 75%, stated that writing was easy during the intervention session, with the fourth participant stating it was 'okay'. When asked if they would like to do the writing activity again at a later date, three participants indicated they would, while one participant indicated he would not like to write again using the intervention. When asked why, he stated he wanted to have Earned Free Time instead. Following their last study session participants completed post-intervention surveys. All participants indicated that they enjoyed the writing activity that day; all stated that the writing was easy, and three of the four participants indicated they would like to write again another time. The fourth participant, Thanos, stated he would not like to do writing with the Clicker Writer app again because he "wants to write with a pencil like my friends", which is a skill he does not currently possess and that is difficult for him due to apraxia. Participants' responses indicate strong social validity for CTD and sentence frames as an intervention for sentence construction using TAI.

Blind Rater

Following the final study intervention session in which the blind rater observed Princess, she completed a social validity survey. She indicated that she did notice a change between baseline and intervention. The changes she noted include that Princess did not guess when writing sentences, as she did in baseline. She identified the words needed for sentence construction in the text and gave responses both verbally and in writing, which was not done previously. The blind rater further noted that Princess was able to write simple sentences independently and engaged in self-correction when a mistake was made. These skills were not demonstrated in the initial observation. In conclusion, the blind rater stated that she believed the intervention was effective for teaching students with IDD to write sentences based on her observations. The blind rater's strong support of the intervention package and positive outcomes resulting from its implementation further solidify the use of CTD and sentence frames as a socially valid intervention for teaching sentence construction using TAI.

After analyzing results from all four social validity measures including parents/caregivers, classroom staff, participants, and a blind rater, the researcher concluded that the use of CTD and sentence frames is a socially valid intervention for teaching sentence construction using TAI to students with IDD during and after a SBL.

Chapter 5. Discussion

The current study had three purposes: (1) to determine the effect of an intervention package that includes CTD and sentence frames on correct word selection for sentences constructed using TAI during a SBL, (2) to determine the effect of the intervention package that includes CTD and sentence frames on correct word selection using TAI for a summary sentence constructed after a story-based lesson, and (3) to determine stakeholders' perceptions of the targeted intervention and outcomes. Upon evaluating the intervention package's effect when implemented with 4 first and second grade students with IDD using a multiple probe across participants single-case research design, results indicate a strong functional relation between CTD and sentence frames (IV) on the correct word selection for constructing sentences using TAI (DV). This was demonstrated through the replication of a therapeutic effect across participants (WWC, 2010). While three replications at different points in time are required to show a therapeutic effect (Horner et al., 2005), the researcher in the current study was able to show four replications, which demonstrates greater effect power (Kratochwill & Levin, 2010) and assists in ruling out threats to internal validity (WWC, 2010). In addition to this, as demonstrated through visual analysis of data, there was consistency of level, trend, variability, immediacy of effect, and consistency across phases, all of which support the determination of a strong functional relation. Generalization data indicate that participants were able to generalize the targeted skill, sentence construction, across materials, response modes, and instructors. In addition, all participants maintained skills at levels higher than baseline across both sentence types (range of 62% to 86%), 'I see a ____' (range of 80% to 100%), and 'I read about a ____' (range of 17% to 100%).

Social validity measures revealed that classroom staff and parents/caregivers felt the intervention was effective, that participants "learned a lot" as a result of the targeted intervention, that the strategy could be carried out in the classroom, and that it appeared participants enjoyed the writing intervention. Participants indicated that they liked writing when taught using the intervention package, would like to write again in the future, and found writing easy. Participants further strengthened social validity via their responses to the intervention both during and after sessions. During intervention session 6, Sonic began asking, "Can I use your iPad," before the predetermined page for sentence writing was reached. The iPad he referred to, which was brand new, had only been used for the research study; therefore, his request can be interpreted to indicate a desire to write using the Clicker Writer app. In addition, Sonic demonstrated excitement at his success with writing during the duration of the study by standing up, cheering for himself, and/or seeking high-fives from the interventionist when he successfully wrote a sentence correctly, as revealed by the automated reading of the sentence he constructed. Following intervention, Princess experienced mild to severe dysregulation daily, as writing during a SBL became a preferred activity that she no longer had access to regularly. While her preference for writing strengthened the social validity of the intervention package, the dysregulation resulting from that preference is a noted limitation. Unicorn often responded to successfully writing a sentence and being positively reinforced by the Clicker Writer voice output when she heard the sentence she wrote read aloud and then realized it was correct. This was demonstrated by her jumping up and down, hugging the interventionist, praising herself, laughing, seeking high-fives, and verbalizing, "I did it!" A final informal measure of social validity occurred daily, as each participant asked, "Is it my turn for story-based lessons and writing," indicating a desire to further participate in intervention sessions. While the participant

surveys, which are limited in scope, provide data with which to establish social validity, the participants informal responses give them a more pronounced voice in establishing the targeted intervention as socially valid.

Deeper Examination

The researcher was given a trial subscription to the Clicker Writer app by Crick Software to use during the study. Due to the unexpected duration of the study, the app expired on two occasions, and it was necessary to seek additional trial subscriptions, which Crick Software donated. Believing that the app would be discontinued following the third trial subscription and given that there were still two participants in intervention, the researcher conducted maintenance probes prior to generalization probes to ensure a causal effect over time could be established prior to the Clicker Writer subscription expiring. For this reason, both Princess and Thanos participated in maintenance prior to generalization. The passage of time between the final intervention session and the first generalization session could have impacted their performance on generalization probes, although both participants scored 81% on their first generalization probe which indicates mastery given a mastery criterion of 80%, the typical criterion used to measure proficiency in the classroom. It should be noted that Crick Software donated a 3-year subscription to the researcher mid-study; therefore, the pressure of time was relieved, affording the researcher to conduct generalization prior to maintenance with Unicorn and Sonic. The disparity in timing between intervention and generalization may have had an effect on participants' performance and, thus, make it difficult to accurately compare generalization scores across both sets of participants, Princess/Thanos and Unicorn/Sonic. To get an accurate comparison, the researcher had to compare results within sets. While the study met and exceeded

the requirement for three replications of effect, there were only two replications of effect within the affected time frames as opposed to three.

The Clicker Writer app may have presented a limitation, which was referred to as 'glitching' by participants and was related to the sensitivity of the Clicker Writer app. Participants were instructed to touch the center of each cell gently; however, if a participant touched too hard, it often resulted in two instances of the chosen word being placed in the sentence window as opposed to one. When this occurred, the interventionist or the participant erased the second word. If the participant did not click the center of the cell, another 'glitch' occurred. In these cases, the cells were not activated, and the word choice did not appear in the sentence window. This could have impacted participants' train of thought and, thus, their sentence construction.

Another aspect of the study worth further examination is the length of time delay used. Participants may have been limited by the length of the second time delay round, which was set for five seconds. It may not have allowed adequate time for participants to scan and/or search word selection before making a choice.

Finally, Princess' desire for adult attention paired with SBL and writing becoming a preferred activity resulted in mild to severe dysregulation prior to each study session. This dysregulation typically manifested as Princess repeatedly asking whose turn it was and why it was not her turn, crying, yelling, engaging in verbal threats, and banging on classroom furniture. While the interventionist employed strategies in the participant's behavior intervention plan, and the behaviors subsided in 2-5 minutes, this dysregulation often impacted the beginning of study sessions and resulted in the interventionist instructing participants on ignoring inappropriate behaviors and perseverance. All participants engaged in planned ignoring and continued to work,

although several comments were made related to Princess' dysregulation during the SBL anticipatory set and vocabulary review. Princess engaged in self-regulation, chose an activity from a choice bank provided, and engaged in the chosen activity prior to the intervention beginning, or the start of sentence construction, in all sessions; therefore, the impact of her dysregulation was likely mitigated.

The discussion that follows includes effects of the intervention on the DV, study limitations, suggestions for future research, and suggestions for practice:

Effects of the Intervention on the Dependent Variable

Through visual analysis, a causal effect was established between the intervention (IV), which included CTD and the use of sentence frames, and the DV, or the correct word selection to construct sentences using TAI. This can be seen in the graph found in Figure 10 when comparing the data from each phase with data in the adjacent phase. Following implementation of the intervention, there was an immediacy of effect, a rapidly accelerating trend, an increase in level between conditions, with levels being higher post-intervention, no overlapping data, consistency of data patterns, and minimal variability indicating a causal effect. Participants in the study were able to make correct word selections to construct sentences using TAI both during and following a SBL, during maintenance probes, and during generalization of materials, response modes, and instructors.

Results from this study mirrored the results of several studies on teaching sentence construction to students with IDD. For example, Pennington and Flick (2018a) investigated the use of CTD, the system of least prompts, and sentence frames on sentence writing for students with moderate intellectual disabilities using both objects from preference assessments and random pictures as stimuli. All participants had a baseline mean of 0%, showed growth across

multiple sentence types, and demonstrated emerging generalization of sentence writing, although none reached criterion for all sentence types during generalization probes. Maintenance and generalization of requesting sentences, such as 'I want ____,' were generalized and maintained at a higher level than descriptive sentences. Pennington and Rockhold (2018c) continued research on construction of sentences with students with AU, again using random pictures as stimuli and an intervention package that included CTD, multiple exemplars, and assistive technology. During baseline no participant was able to construct a sentence; however, after intervention, all participants met criterion and, with the exception of one participant for whom maintenance and generalization probes were not conducted, demonstrated maintenance of skills above baseline. No participants in the current study were able to construct sentences via correct word selection in baseline; however, during intervention, generalization, and maintenance phases, all participants showed marked increases in their sentence-writing ability. As with the aforementioned studies, participants demonstrated generalization and maintenance, although generalization and maintenance of the 'I read about a ____' sentences were to a far lesser degree than the 'I see a ____' sentence (see Figure 11 and Figure 12)

In addition to mirroring the results of previous studies, this study also mirrors past interventions. For example, both of the aforementioned studies use CTD as an integral part of the studies' systematic instruction (Pennington & Flick, 2018a, Pennington & Rockhold, 2018c). Likewise, CTD is the foundation of this study's intervention. While all three studies used CTD, previous studies included additional strategies, such as the use of multiple exemplars and the system of least prompts, which were not included in this study's intervention package.

Sentence frames have been used by previous researchers with an interest in writing instruction for students with IDD (Lee et al., 2010; Pennington et al., 2018b). Pennington et al.

(2018b) used both CTD and sentence frames to teach three middle schoolers to write three different sentence formats: (1) 'The (subject) is (adjective),' (2) 'The (subject) (verb)', and (3) 'The (subject) feels (adverb)'. While both this study and the study by Pennington et al. used sentence frames as part of the intervention, the study by Pennington et al. (2018b) focused on the generation of sentences related to a picture and character, while this study focused on the generation of sentences related to the content and illustrations of a story being read aloud.

Numerous studies on teaching writing to students with IDD have included TAI as a component of the intervention package or mode of accessing writing. In 2011, Pennington et al. used Clicker 5, a writing app, paired with simultaneous prompting to teach story-writing to students with autism. Pennington et al. (2014) continued the use of TAI when teaching students with autism to write stories using a selection-based writing program named Pixwriter™. During the study, word selections were presented in categories that included subject, verb, article, nouns, and adjectives. While the current study taught sentence construction as opposed to story-writing and word selection was presented in random order as opposed to in categories, similar to the Pennington et al. 2011 study, all three studies' results indicate that the use of TAI supports access to writing for students with IDD and results in positive outcomes related to written expression, whether that be sentence-writing or story-writing.

The error correction procedure used in this study is similar to that used in a study by Mims et al. (2017) in which the 'GoBook', an app used to teach opinion writing to students with IDD following a read aloud, eliminated incorrect responses to identify the correct response following an established CTD. During the current study, the interventionist used the controlling prompt of touching the correct answer, thus eliminating the incorrect answers. Pennington et al. (2018a) also used a strategy that eliminated all incorrect answers; however, they used physical

guidance to support the participant in making the correct choice. In each study, students were led to the correct choices by eliminating incorrect choices.

Finally, and most importantly, this study extends the work of previous researchers, in particular the work of Dr. Robert Pennington (Pennington et al., 2018a; Pennington et al., 2018b), by embedding the intervention package in a natural setting, natural routine, and natural academic instruction. Rather than presenting random pictures or content about which the participant was expected to write, the current study used age-appropriate books that were found in general education classrooms and that were read to same-age peers by general education teachers. Instruction was delivered during the participants' regularly scheduled literacy groups and delivered by their typical literacy instructor. By embedding the intervention in a natural context, the study furthers professional knowledge in the field of special education, adds to the ecological validity of the intervention, and increases the evidence-base by demonstrating that the use of an intervention package including CTD and sentence frames, when supported by the use of TAI, is a feasible, effective, and socially valid method for teaching correct word selection for construction of sentences related to academic content.

Limitations

There were several limitations noted during and within the study. First, given that the study was conducted during the participants' natural routine and literacy instruction, there were typical classroom interruptions and distractions including other participants requesting to go to the bathroom, the school secretary stopping by to retrieve a child, and other students in the classroom experiencing mild to severe dysregulation. Such dysregulation of a peer and the distraction that resulted from it resulted in Unicorn experiencing difficulty hearing the interventionist during her second generalization session and, thus, the session being

discontinued. Discontinuation occurred following introduction of story vocabulary and before the teacher began reading the story or the intervention was implemented; therefore, study results were not compromised by this discontinuation.

A second limitation related to the study was that the implementation plan stated that the intervention would be conducted with one participant at a time. Given the study was conducted by the interventionist, who also served as the classroom teacher, implementing the intervention with only one participant put time constraints and session limitations on the study. Sessions lasted from 17 minutes (maintenance) to 28 minutes (intervention) depending on the participant, length of storybook, and phase, which only allowed for two study session per day given the natural length of participants' literacy group. Rather than carrying out intervention implementation five days a week as the researcher would have liked, each participant was afforded only three intervention sessions per week. This may not have maximized the effect of the intervention and, in fact, may have hindered the participants' progress, as three to four days may have passed between intervention sessions. This time lapse may also have provided an opportunity for regression of skills from one intervention session to the next.

Given constraints beyond her control, the researcher was unable to begin the study until November of the current school year. As a result, both Thanksgiving Break and Winter Break occurred during the duration of the study. While Thanksgiving Break is not likely to have impacted study results, as all participants were in initial baseline phase and scored 0% across all baseline points and probes, Winter Break may have impacted Princess' performance, as it occurred between her sixth and seventh intervention sessions, although this is unlikely since she scored 57% on session 6 and 93% on session 7. In addition to this, two other school holidays resulted in 4-day weekends which, given that study sessions occurred three days a week per

participant, could have limited the progress of Thanos and Unicorn, both of whom were in intervention during one of the school closures; however, if so, the impact was small, as Unicorn scored 81% pre-school closure and 76% during her first session after school reopened, and Thanos scored 90% pre-closure and 86% post-closure.

Given that the study was conducted during the COVID-19 pandemic, two of the participants' participation was impacted due to COVID-related absences or other illness. COVID-related absences is defined as an absence due to having COVID or being in quarantine as a result of being a close contact. These participants, Thanos and Sonic, were at various phases of the study when these absences occurred. Thanos' absences occurred between his last intervention phase (score of 100) and his first maintenance phase (score of 81%). Sonic had COVID-related absences twice during the duration of the study, first between his last zero-second time delay session and his first five-second time delay session, and then between his last intervention session and his first generalization session.

Due to a COVID-related absence, Thanos was not present during the last session allotted for the initial baseline sessions. Again, given the time constraints related to the expiration of Clicker Writer and the recommendations of Kratochwill et al. (2021), only four initial baseline probes were conducted with Thanos. While this may be seen as a weakness based on WWC recommendations, given that Thanos scored 0% on correct word selection for sentence construction during four baseline probes and one pre-intervention probe, indicating stability, the researcher does not believe this to be a limitation.

Participants were limited to the two sentence types included in the intervention implementation plan. Being bound by two sentence frames limited the opportunity for a variety

of student-generated sentences and, thus, limited their written expression and the scope of their responses.

Another limitation included the management of data, including study data, data on SBL targeted skills, and IEP data on participants' responses to various types of comprehension questions (who, what, where, etc.), which resulted from a collaborative effort between the interventionist and participants' speech and language pathologist, was taxing on the interventionist. Thus, management of study data, instructional data, and IEP goal data was a limitation of the current study, as all three forms of data were essential for progress monitoring.

Finally, it may be viewed as a limitation that Thanos had four initial baseline probes rather than five and only one probe prior to entering intervention rather than the recommended three probes; however, due to COVID-related absences, time constraints related to the expiration of the Clicker Writer trial subscription, a consistent zero baseline level, the fact that he was able to identify all words required for sentence construction, and to avoid student frustration related to remaining in baseline for an extended period, the decision was made to move forward with the less than recommended baseline probes before introducing Thanos into intervention.

While limitations to the study are noted, visual analysis of participants' data across phases and participants indicates the use of CTD and sentence frames, paired with the support of TAI, as an effective strategy for teaching sentence-writing to students with IDD.

Recommendations for Future Research

The results of this study suggest that students with IDD are able to learn to construct sentences using word selection during natural academic instructional periods. They also indicate that teachers are able to implement the intervention package with high fidelity and positive student outcomes when implemented with one participant at a time. In order for the intervention

to be feasible, effective, and efficient in a classroom setting, further research should be done on the implementation of the intervention package with more than one participant at a time or even in a small group format. Students with IDD who receive special education services for academics typically receive instruction in small groups rather than one-on-one.

A second recommendation for future research includes expanding the context in which the intervention is implemented to include informational texts. The use of informational texts would allow educators to employ the intervention and use of SBL in academic areas other than literacy, including Science and Social Studies. By doing so, doors may be opened to greater inclusion in the general education curriculum and classroom, which is a third recommendation for future research, and greater expression of knowledge and creativity by students with IDD. Given the aforementioned mandates for access to and inclusion in the general education curriculum, researchers may want to consider implementing the intervention package in an inclusive setting and with grade-level and/or adapted grade-level materials.

Participants' written expression was limited by the number of sentence types taught. While the effect of the intervention package of the construction of those two sentence types is promising, researchers should continue to investigate the ability of students with IDD to write a variety of sentences, including knowledge-based, opinion-based, and descriptive sentences, on a variety of topics.

Future researchers may want to consider adhering to the true fidelity of the CTD procedure in that there should be individualized wait times for each participant rather than a standards set wait time. The decision to set a 5 sec. wait time was made based on previous experience with implementing CTD with these students, yet the wait time was being applied to a novel skill (i.e., scanning randomized response options on the Clicker software). Given that five

seconds may not have been sufficient for participants to scan and/or search word selection choices, the current researcher recommends that be extended to 8-10 second minimum to allow for additional time.

Error analyses revealed the most common errors occurred at the word selections 'read' and 'about'. The researcher observed that participants who erred at 'read' often stated that they were looking for the word 'see,' a word required for the first sentence type. In addition to this, it was observed that participants who erred at 'about' most often wrote the sentence, 'I read a ____,' during generalization and maintenance phases. Based on these observations, researchers may want to consider the inclusion of multiple exemplars (e.g., example and nonexample training prior to the study beginning) Pennington et al. used this approach but it was not implemented as a part of this study. in future intervention packages.

Finally, given the success of (Brock & Huber, 2017; Collins et al., 2001) and recommendation for peer-mediated instruction (Pennington & Delano, 2012) when working with students with IDD, including when teaching sentence-writing and during the writing process, researchers are encouraged to investigate the effect of peer-mediated instruction on writing outcomes to determine if there is evidence that such instruction should be included in a comprehensive writing program for students with IDD.

Implications for Future Practice

The current study and others (Mims et al., 2007; Pennington et al., 2018a; Pennington et al., 2018b; Pennington et al., 2018c; Pennington et al., 2019b) support the inclusion of students with IDD in writing instruction and provide evidence that when given explicit, systematic instruction using evidence-based practices, students with IDD can construct both sentences and stories; therefore, writing instruction should be a part of all students' regular academic

instruction, including students who are unable or not yet able to write using traditional writing instruments such as students with apraxia. Given the varied writing abilities of students with IDD, educators should consider alternative ways for students to access writing, including the use of technology-aided writing supports such as the use of the Clicker Writer app. Thanos, who experienced challenges in writing related to apraxia, demonstrated mastery of sentence construction, generalization and maintenance of skills, and excitement at the opportunity to write when he had previously resisted writing. The use of Clicker Writer became a starting point for Thanos' use of alternative ways of accessing writing with a goal of fading its use and introducing keyboarding. For this reason, educators may want to consider the use of a word selection-based writing program for early writers who may experience writing challenges due to apraxia or other access limitation.

While some individuals with disabilities experience challenges related to writing (Griffin et al., 2006; Myles et al., 2003), many people with autism have limited ability to communicate via vocalizations (Miranda-Linne & Melin, 1997). Teachers of students with autism are encouraged to consider alternate forms of communication, including the use of writing, either by hand or digitally, as a possible option for those who experience challenges with oral communication.

Given that the current study was conducted in a separate special education setting that had natural interruptions and distractions, along with positive generalization outcomes, educators may want to consider using the intervention package for students served in an inclusive setting where interruptions and distractions often occur. Implementation of the intervention in an inclusive setting would be especially beneficial in grades in which students are being instructed

in the early stages of writing and when general education students are naturally using sentence frames.

Because each student's needs are individual, as are their modes of accessing information, expression, and, in this case, writing, it is imperative that teachers and related service providers work together to meet the cognitive, communication, and physical needs of the writer (Laverdure et al., 2017). Research has shown that written language is closely tied to oral language development (Shanahan, 2006). Although some students with IDD may not be able to speak, through writing they can still communicate via the use of words. As there have been instances in which oral communication by individuals with IDD has increased as a result of learning to write sentences (Pennington et al., 2014), the researcher suggests that teachers work in collaboration with students' speech and language pathologist (SLP) to determine sentence type and structural content. For example, if the student is working on increasing vocabulary via labeling, the teacher may want to provide instruction on the sentence 'I see a ____." If the SLP is targeting the inclusion of descriptors, the teacher may want to include adjectives in targeted sentences. Likewise, it is important that the teacher, along with occupational therapists, physical therapists, and assistive technology specialists collaborate on access to writing and writing systems used, including traditional and technology-based systems. Through collaboration with all stakeholders, including parents/caregivers who have unique insight into possible writing content, school-based teams maximize a writer's access and, thus, his/her/their writing outcomes.

While it was not appropriate for the study given that there would be threats to internal validity, educators are encouraged to allow students to create and print a hard copy of their final product. Not only does this serve as an artifact that allows educators to track student progress, but it also allows student writers to experience success and share their writings with family,

friends, classroom, staff, etc. By providing students with hard copies of their final products, educators allow students with IDD to participate in writer/reader exchanges and receive reinforcement resulting from those exchanges.

Given the intervention implementation plan, the researcher was not able to allow Unicorn the opportunity or time to self-correct, although she clearly protested the offer of support by holding the interventionist's hand down when she attempted to reach for the visual used during error correction. Since classroom teachers have freedom to add to the intervention package, the researcher encourages teachers to add additional interventions to the package based on students' needs. For example, were the researcher to conduct a similar study in the future, she would explicitly teach the word selection choices prior to teaching sentence construction, increase the length of the second CTD round, and use multiple exemplars (Pennington & Rockhold, 2018 c) as part of the intervention package. The researcher would also encourage teachers to honor students' self-advocacy and self-determination when possible, such as honoring Unicorn's self-advocacy by allowing her the opportunity to attempt self-correction prior to error correction.

In addition to this, as management of data and time were noted as limitations of the current study, the researcher encourages teachers, who may find themselves in a similar situation should they implement the study's writing intervention, to streamline data collection so it is more manageable and efficient. For instance, having only one data sheet with the data to be collected listed in the order of instructional delivery would simplify the data collection process.

Although the study was conducted with one participant at a time, teachers may want to consider creating SBL containing multiple opportunities to construct sentences and explore implementing the intervention with a small group of students or partnering with a researcher to explore implementation of the intervention with more than one participant. By doing so, the

teacher would be able to meet the instructional needs of multiple students within a lesson, as opposed to one, and provide a larger number of writing opportunities per week.

Finally, educators should explore ways they can embed more than one academic area in a lesson. For example, they may choose to embed writing in literacy, as the current researcher did, or embed language activities in writing, such as the sharing of students' final writing products.

Conclusion

While there remains a dearth of information on evidence-based practices for teaching writing to students with IDD, researchers have begun to investigate strategies that are feasible, effective, efficient, and can be used across students with a variety of writing abilities. The current study demonstrates the effectiveness of CTD and sentence frames in teaching students with IDD correct word selection for constructing sentences using TAI. Suggestions for future research were noted given that further research is needed to establish the intervention package as an evidence-based practice, and, given that the purpose of the study is to provide strategies that can be implemented in natural settings, routines, and instruction, implications for practice were also noted. With the diversity of skills and needs in the classroom setting in mind, the researcher also offered suggestions for practical application and instructional delivery to assist educators in meeting the diverse needs of their students. Finally, recognizing the importance of writing in daily life, social connection, and inclusion, and given laws that mandate students with disabilities have access to and inclusion in the general education curriculum, including the writing curriculum, the researcher stressed the importance of writing instruction for all students, including students with IDD.

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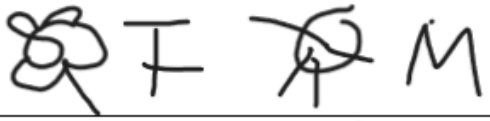
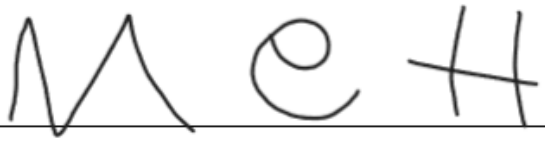
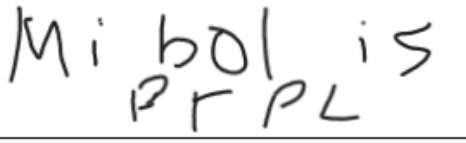
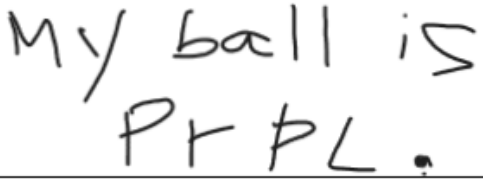
APPENDIX: Figure 14

Developmental Stages of Writing

Pre-Literate Writer	
Scribble: The writer makes random circular, straight, and curved marks on paper without conveying a message.	
Symbolic Scribble: The writer draws pictures or makes marks on paper than is intended to convey a message, although the writer must state the message.	
Directional Scribble: The writer scribbles from left-to-right with the intention of conveying a message.	
Symbolic and/or Mock Letters: The writer writes using formations that resemble letters and/or numbers, although these are not intentionally made.	
Emergent Writer	
Strings of Letters: The writer strings letters together from left-to-right, often capital letters in his/her/their name, that typically have deviation in size and formation.	
Groups of Letters: The writer writes strings of letters that look like words with spaces between them.	
Labelling Pictures: The writer labels pictures by writing the beginning sounds found in the pictures' label.	
Environmental Print: The writer copies and/or writes words he/she/they find in their natural environments. These writings may include letter reversals	

Transitional Writer	
Letter/Word Representation: The writer writes using the first letter of the word, or beginning sound, to represent the entire word.	
First/Last Letter Representation: The writer writes using the first and last letter of the word, or beginning and end sounds, to represent the entire word.	
Medial Letter Sounds: The writer begins to spell words phonetically, with many words containing a beginning, middle, and end sound, and spacing between words.	
Fluent Writer	
Beginning Phase Writer: The writer uses all skills obtained previously to write a message about his/her/their illustrations using phrases.	
Sentence Writing: The writer writes a sentence or multiple sentences that convey a message focused on a topic. Some punctuation may be used with some words spelled correctly and some phonetically.	
Six Traits of Writing: The writer writes using the six traits of writing, including ideas, word choice, organization, voice, sentence fluency, and conventions.	

Note. Adapted with the permission of Seemeeu Park Preprimêre Skool

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